Thomas Jefferson National Accelerator Facility
U.S. Department of Energy
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JEFFERSON LAB
SITE ENVIRONMENTAL REPORT
For Calendar Year 2001

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SURA/Jefferson Lab
Office of Technical Performance
EH&S Reporting
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TABLE OF CONTENTS

Exhibits

ABBREVIATIONS AND ACRONYMS

A C M	Asbestos-containing material	**E P Gs**	Emergency Planning and Response Groups
A E A	Atomic Energy Act	**E P P**	Environmentally Preferable Purchasing
A L & R	Administrative Laws and Regulations	**E S A**	Endangered Species Act
A P	Affirmative Procurement	**E S & H**	Environment, Safety, and Health
A R C	Applied Research Center	**F D S**	Floor Drain Sump
B q	Becquerel	**F E L**	Free Electron Laser
B W X	BWX Technologies	**F I F R A**	Federal Insecticide, Fungicide, and Rodenticide Act
C A A	Clean Air Act	**F O N S I**	Finding of No Significant Impact
C A A A	Clean Air Act Amendments of 1990	**F Y**	Fiscal Year
C E B A F	Continuous Electron Beam Accelerator Facility	**G e V**	Giga-electron Volts
C E R C L A	Comprehensive Environmental Response, Compensation, and Liability Act of 1980	**G S A**	General Services Administration
C F C	Chlorofluorocarbon	**H R S D**	Hampton Roads Sanitation District
C F R	Code of Federal Regulations	**H S**	Hazardous Substance
C i	Curie	**H W C**	Hazardous Waste Coordinator
C O D	Chemical Oxygen Demand	**I A**	Independent Assessment
C W A	Clean Water Act	**I R**	Infrared
C X	Categorical Exclusion	**I S M**	Integrated Safety Management
C Y	Calendar Year	**I W D R**	Industrial Wastewater Discharge Regulations
D E Q	(Virginia) Department of Environmental Quality	**k g**	Kilogram
D O D	U.S. Department of Defense	**L L W**	Low Level Radioactive Waste
D O E	U.S. Department of Energy	**L S A**	Line Self-Assessment
D O T	U.S. Department of Transportation	**μ g/L**	Micrograms per Liter
E2	Energy Efficiency	**μ S v**	MicroSievert
E A	Environmental Assessment	**μ m h o s/L**	Micromhos per Liter
E H M	Environmentally Harmful Material	**M^3**	(Cubic) Meters
E H S	Extremely Hazardous Substance	**M A P E P**	Mixed Analyte Performance Evaluation Program
E H & S	Environment, Health, and Safety	**M B T A**	Migratory Bird Treaty Act
E M	Emergency Management	**m g/ L**	Milligrams per liter
E M L	Environmental Measurements Laboratory	**M G D**	Million gallons/day
E M S	Environmental Management System	**m r e m**	Millirem
E O	Executive Order of the President of the United States	**M S D S**	Material Safety Data Sheet
E P	Environmental Protection	**M S L**	Mean Sea Level
E P A	Environmental Protection Agency	**m S v**	MilliSievert
E P C R A	Emergency Planning and Community Right-to-Know Act of 1986	**MT**	Metric Ton

ABBREVIATIONS AND ACRONYMS (cont.)

N A A Q S	National Ambient Air Quality Standards	**S D W A**	Safe Drinking Water Act
N A S A	National Aeronautics and Space Administration	**S E R**	Site Environmental Report
N C P	National Oil and Hazardous Substances Pollution Contingency Plan	**S N S**	Spallation Neutron Source
N E L A C	National Environmental Laboratory Accreditation Conference	**S P C C**	Spill Prevention, Control, and Countermeasure (Plan)
N E P A	National Environmental Policy Act	**S Q G**	Small Quantity Generator
N E S H A P s	National Emission Standards for Hazardous Air Pollutants	**S R F**	Superconducting Radiofrequency
N H P A	National Historic Preservation Act	**S U R A**	Southeastern Universities Research Association, Inc.
O D S	Ozone-Depleting Substance	**S v**	Sievert
O R O	Oak Ridge Operations – (DOE)	**S W D A**	Solid Waste Disposal Act
O S H A	Occupational Safety and Health Act	**T D S**	Total Dissolved Solids
P 2	Pollution Prevention	**T J N A F**	Thomas Jefferson National Accelerator Facility
P A A A	Price-Anderson Amendments Act	**T O C**	Total Organic Carbon
P C B	Polychlorinated biphenyl	**T P Q**	Threshold Planning Quantity
p C i/ l	Picocuries per liter	**T R I**	Toxic Release Inventory
P P A	Pollution Prevention Act	**T S**	Total Solids
Q A	Quality Assurance	**T S C A**	Toxic Substances Control Act
Q A P	Quality Assessment Program	**T S S**	Total Suspended Solids
Q C	Quality Control	**U V**	Ultraviolet
R A D C O N	Radiological Control	**Universal Labs**	Universal Laboratories, Inc.
R a d C o n	Radiation Control (Group)	**V A C**	Virginia Administrative Code
R B M	Radiation Boundary Monitor	**V D H R**	Virginia Department of Historic Resources
R C R A	Resource Conservation and Recovery Act	**V P A**	Virginia Pollution Abatement (Permit)
R Q	Reportable Quantity	**V P D E S**	Virginia Pollutant Discharge Elimination System (Permit)
R & D	Research and Development	**W M i n / P 2**	Waste Minimization/Pollution Prevention
S A / Q A	Self-Assessment/Quality Assurance	**W S S**	Work Smart Standards
S A R A	Superfund Amendments and Reauthorization Act		

JEFFERSON LAB SITE ENVIRONMENTAL REPORT
FOR CALENDAR YEAR 2001

Section 1
Executive Summary
Purpose

This report presents the results of environmental activities and monitoring programs at the Thomas Jefferson National Accelerator Facility, known as Jefferson Lab, for calendar year (CY) 2001. The report provides the U.S. Department of Energy (DOE) and the public with information on radioactive and non-radioactive pollutants, if any, added to the environment as a result of Jefferson Lab operations. The report also summarizes environmental programs, initiatives, and assessments that were undertaken in 2001. The objective of the Site Environmental Report (SER) is to document Jefferson Lab's active environmental protection program that protects the environment and public health.

Jefferson Lab's main purpose is to make available a research facility to support the nuclear physics community and the nation. The Continuous Electron Beam Accelerator Facility (CEBAF) at Jefferson Lab provides an electron beam to three experimental halls where a variety of physics experiments are conducted. Correlative programs where environmental protection is considered are: the Free Electron Laser (FEL); Superconducting Radio-Frequency (SRF) research and development; and cryomodule development for the DOE's Spallation Neutron Source (SNS) project.

Major Site Programs

CEBAF: The accelerator continued to deliver electron beams at energies close to 6 GeV (Giga-electron Volts) to meet the variety of needs of the experimenters in Halls A, B, and C. Jefferson Lab has completed 45 experiments and partially completed another 27 between facility commissioning and the end of CY 2001. Major experiments were conducted in all three halls. One Hall A experiment examined some of the rarest subatomic particles known to exist: K-mesons or kaons. Hall B experiments studied certain kinds of exotic matter, such as strange quarks. The data and analysis from this batch of experiments could shine light on the nature of the strong interactions between quarks. Another Hall B experiment delved into the "spin" of protons and neutrons, and in Hall C, a major experiment set the standard for the evidence of the onset of quark effects in the nucleus of the atom.

During 2001, a critical juncture was reached in the analysis and research and development (R&D) work on the proposed upgrade of CEBAF to 12 GeV. This upgrade in electron beam energy levels would also include the building of a fourth experimental hall, which would be named Hall D. The National Science Advisory Committee rated the upgrade as one of the science programs it most highly endorsed, supported, and recommended.

SRF: Superconducting Radio-Frequency Technology R&D efforts were enhanced in 2001 to better support the existing accelerators. Improvements were made to the original CEBAF cryomodule design to support current 6 GeV and future, higher energy operations. Also, SRF improvements and applications to meet SNS needs continued.

FEL: On November 18, 2001, the Lab's Infrared (IR) Demo Free Electron Laser was decommissioned and shutdown to begin a major, 10-month upgrade project. At that time it was a kilowatt level light source with output in both the IR and ultraviolet (UV) wavelength. Once the upgrade is complete, the

machine will be able to produce more than 10,000 watts of IR light and kilowatt levels of UV light. The FEL supports basic science research and serves universities, private industry, the U.S. Navy, and the U.S. Air Force. During 2001, FEL experiments included: production of coatings and thin films for electronics and microcomponents, and production of carbon nanotubes. CY 2001 marked the halfway point of the two-year, 10 kilowatt upgrade project to add two new cryomodules to the FEL accelerator, a new injector to double the quantity of beam produced, and a new "wiggler" magnet to help improve operational capabilities.

SNS: The Spallation Neutron Source project is an ongoing partnership involving six DOE national research centers - Jefferson Lab, Argonne, Brookhaven, Lawrence Berkeley, Los Alamos, and Oak Ridge - to design and construct what will be the most powerful spallation neutron source in the world in Oak Ridge, Tennessee. The SNS will provide intense pulsed-neutron beams for scientific research and industrial development. Jefferson Lab's contribution is to develop and build the superconducting radiofrequency cryomodules and to design the cryogenic support facilities for the project. Several SNS milestones were reached in 2001.

The *E* in Environment, Health, and Safety (EH&S)

Organization and Management: Ultimate responsibility for protection of the environment and public health rests with the Lab Director, while line management implements the goals within their areas of responsibility. EH&S staff provide support to their line management and share their expertise with the Lab as a whole.

Integrated Safety Management (ISM) System: Through ISM, Jefferson Lab incorporates EH&S requirements into all work procedures, striving towards continuous improvement in EH&S and in the nuclear physics research program.

Jefferson Lab Work Smart Standards (WSS) Process**:** The goal of the WSS process at Jefferson Lab is to enable an EH&S system that is both effective and cost-efficient. The WSS Set, identified through the process, is comprised of the laws, regulations, and standards necessary and sufficient to ensure health and safety and to protect the environment with respect to hazard issues that are relevant to Jefferson Lab. The WSS Set and other associated obligations are reviewed and adjusted on a regular basis to address changes in either site activities or regulations. More information is provided in Section 3.

EH&S Performance Measures: These DOE/SURA (Southeastern Universities Research Association, Inc.) contract-based measures, used to evaluate Jefferson Lab's EH&S performance, include items such as recycling and hazardous waste minimization. These are discussed in Section 3.

Inspections and Appraisals: The Virginia Department of Environmental Quality (DEQ) and the Hampton Roads Sanitation District (HRSD) performed inspections in 2001. Section 3 presents the minor concerns identified in these inspections. Most of the deficiencies identified during a 1999 ISM review were closed in 2001. The DOE Site Office's Overlay Report included an "outstanding" rating for SURA in the EH&S category. These are discussed further in Section 4.

Implementation of 10 CFR 835: This DOE Code of Federal Regulations (CFR) worker radiation protection rule is enforced at Jefferson Lab and identified in the WSS Set mentioned above. The Jefferson Lab Radiation Protection Program Plan is used to implement the rule on site, and is revised as identified by the responsible line management. This is also addressed in Section 3.

Implementation of NEPA: Most facility additions and modifications are subject to review under the National Environmental Policy Act (NEPA). The initial Jefferson Lab construction and an upgrade to CEBAF were addressed in the 1987 and 1997 Environmental Assessments (EAs). Routine Lab activities are covered under site-specific Categorical Exclusions (CXs). New activities that occurred in 2001 received NEPA CX authorizations. NEPA is discussed further in Section 3.

Environmental Management System (EMS) Implementation: EMS implementation is addressed through the Lab's ISM System Plan. This is the subject of the 6700 series of chapters in the Jefferson Lab EH&S Manual. Chapter 6710, *Environmental Protection Program*, is being upgraded to clarify management roles regarding the protection of the environment and public health. Jefferson Lab committed to broaden the scope of the ISM System plan by incorporating additional EMS core elements and principles during Fiscal Year (FY) 2002. The primary objective of ISM is to make safety, health, and environmental protection a part of routine business at Jefferson Lab.

Summary of Environmental Results in 2001

Compliance
Jefferson Lab complied with applicable Federal, State, and local environmental laws, regulations, and DOE guidance during 2001. As a consequence, Jefferson Lab operations had no discernable impact on public health or the environment. Radiation-related issues, especially those dealing with water resources and public health, are highlighted in this report.

The Jefferson Lab EH&S Manual, which addresses many environmental topics, was updated and improved to ensure that new compliance initiatives were incorporated in 2001.

Radiological Monitoring
Water: Radiation measurements are made at the groundwater dewatering sump and groundwater monitoring wells located near the accelerator and the experimental halls. Sampling intervals vary from quarterly to annually. There were no readings above background in 2001. No analyte, except gross beta, was detected above the permit-required sensitivity levels. Note that gross beta was detected, but at normal background levels. Therefore, no accelerator-produced radionuclides were detected in our groundwater.

Radioactive water is generated inside the underground accelerator complex and a small quantity is discharged under permit to the sanitary sewer system. Sampling is routinely performed prior to any discharge to ensure permit limits are maintained. Sampling results are reported both monthly and quarterly.

Airborne: Radiological airborne emissions at the site boundary are addressed under the Environmental Protection Agency's (EPA) National Emission Standard for Hazardous Air Pollutants (NESHAPs) requirements. Jefferson Lab is below emission levels that trigger monitoring or reporting, but continuous measurements are made to verify emission calculations. Though not required, CY 2001 values were reported to the EPA. One result reported to the EPA for 2001 was that the total maximum offsite dose from radiological airborne releases was less than 0.011 mrem/yr (millirem/year). This amount is insignificant when compared to the EPA regulatory public air-dose limit of 10 mrem/yr, which is the amount of exposure that is comparable to one typical chest x-ray.

The accelerator site boundary monitors are used to determine offsite direct radiation dose to the public due to Jefferson Lab operations. The dose values for 2001 were within Jefferson Lab's allowable limits - the highest direct radiation level measured was only 7% of the DOE annual dose limit of 100 mrem.

Since these doses are well under any regulatory or site administrative limits, there are no impacts on the public from any of these radiation sources. A complete discussion is provided in Section 5.

Non-radiological Monitoring
Jefferson Lab's non-radiological environmental monitoring program also verified compliance with applicable environmental program requirements. The program included monthly and quarterly industrial wastewater monitoring, quarterly groundwater sampling at the dewatering sump and at some of the monitoring wells, and quarterly cooling water discharge sampling.

Items of Interest in 2001

Highlights in Jefferson Lab's 2001 environmental protection and pollution prevention program included:

- Recycling of about 1700 pounds of fluorescent lamps, about 7300 pounds of used oil, and other materials;
- Successfully developing and implementing two fully-functioning office product recycling centers;
- Maintaining a top rating in the Lab's performance measure that addresses recycling compared to disposing of waste in a landfill;
- Improving performance in the procurement of EPA-designated recycled-content products, 84% purchased in FY 2001, almost a 20% improvement over FY 2000;
- Receiving a "Gold Pretreatment Excellence Award" from the local sanitation district; and,
- Successfully and safely accomplishing the first shipment of low-level radioactive waste.

SECTION 2
INTRODUCTION

2.1 GENERAL

This report provides the public with a summary of CY 2001 environmental protection and public health items that characterize the environmental management performance at Jefferson Lab. This report addresses the Lab's compliance status with applicable requirements, standards, and contractual commitments. Information on related assessments, initiatives, and site programs is also included.

The term "safety" in the ISM program includes environmental protection and public health, as well as worker safety and health (all are generally termed EH&S). EH&S responsibilities are incorporated into each employee's position description as described in the Jefferson Lab ISM System Plan. The DOE validated the ISM System Plan in 1999. Refer to Section 4.1 for more information.

2.2 LABORATORY MISSION

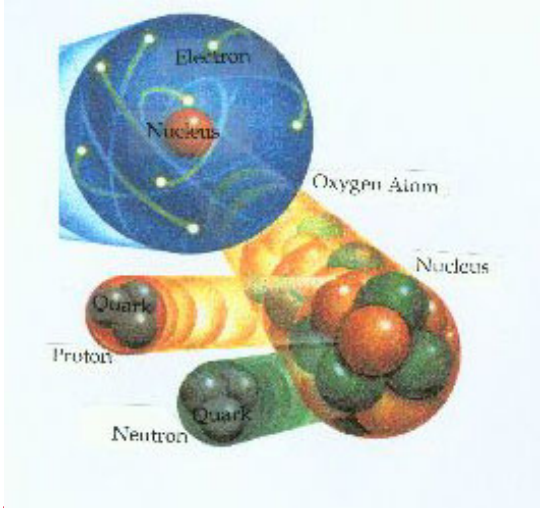
Jefferson Lab, formerly known as CEBAF, is a national accelerator facility managed by SURA for the DOE. The accelerator complex portion of the Lab still retains the name CEBAF and includes three underground halls that house the physics program experiments. Jefferson Lab's mission statement addresses quality and excellence in research, community partnership, and environment, health, and safety.

The original Jefferson Lab mission evolved from the nuclear science community's recognition of the need for a state-of-the-art electron accelerator with a continuous high current electron beam with electron energies in the multi-billion electron volt region. The accelerator is used to study quark structures and behaviors and the forces governing the clustering of individual nucleons in the nuclear medium.

There were improvements in CEBAF operations in support of the physics program experiments in 2001, including the delivery of electron beams at energies close to 6 GeV to meet the variety of needs of the experimenters in Halls A, B, and C. Since the Lab began operations, through the end of 2001, researchers had completed 45 experiments and partially completed another 27 between facility commissioning and the end of CY 2001 using all three halls. Each of the halls examined different research areas that included the subatomic K-meson particles at Hall A, strange quarks and the nature of their interactions in Hall B, and one Hall C experiment set the standard for evidence of the onset of quark effects in the atomic nucleus.

Other major activities in 2001 focused on SRF R&D and FEL operations. SRF R&D efforts were enhanced in 2001 to better support the existing accelerators. Improvements were made to the original CEBAF cryomodule design to support current 6 GeV and future 12 GeV operations. Jefferson Lab's expertise in SRF technology is being used to design and build the cryomodules and refrigeration system for the DOE's SNS that is being built in Oak Ridge, Tennessee. Use of the FEL by Jefferson Lab, industrial, U.S. Department of Defense (DOD), and university partners also continued in 2001.

A critical juncture was reached during 2001 in the analysis and R&D work on the proposed upgrade of CEBAF to 12 GeV. This upgrade in electron beam energy levels includes the building of a fourth experimental hall, which will be named Hall D.



Atomic Structure

2.3 ENVIRONMENTAL REVIEW

An environmental assessment, termed EA, performed under NEPA, was conducted prior to construction of CEBAF (February 1987), resulting in a Finding of No Significant Impact (FONSI). The EA and other NEPA-related documentation have been reviewed periodically with no significant changes noted. A 1997 EA, that also yielded a FONSI, addressed CEBAF upgrades and FEL-related activities. An EA to review five proposed construction projects was being prepared in 2001. Refer to Section 3.10.1 for additional NEPA information.

2.4 SITE LOCATION

Jefferson Lab is located in Newport News, Virginia. Newport News is bounded on the east by York County and the city of Hampton; on the north by James City County and the city of Williamsburg; on the west by the James River; and, on the south by the Hampton Roads waterway. Jefferson Lab is located just east of Jefferson Avenue, a main area thoroughfare, and is less than one mile to the west of Interstate 64. The site is just south of Oyster Point Road and just north of Middle Ground Boulevard. The Jefferson Lab Vicinity Plan is included as Exhibit 2-1. Two schools, a cemetery, and railroad tracks serving the local rail system are located within one mile of the site. Newport News-Williamsburg International Airport is located two miles to the north. Exhibit 2-2 shows the Jefferson Lab site proper.

Jefferson Lab is sited in the northern section of Newport News at an average elevation of 34 feet above mean sea level (MSL). The site elevation ranges from 29 to 35 feet above MSL, which is above the 100-year floodplain level of 13 feet above MSL. The Jefferson Lab site is located in the coastal plain of the lower York-James Peninsula, and is in the Brick Kiln Creek watershed, which discharges into the Big Bethel Reservoir. Big Bethel Reservoir is operated by the U.S. Army and provides drinking water to Fort Monroe, Langley Air Force Base, and the National Aeronautics and Space Administration (NASA)-Langley Research Center.

2.5 SITE HISTORY AND DESCRIPTION

Prior to Jefferson Lab, there were several users of this general area. In 1942 and 1943, the DOD acquired most of the Oyster Point area that included all of the land presently used by Jefferson Lab. The U.S. Air Force acquired the land in 1950 and installed a BOMARC missile site on a portion of the land immediately to the east of the Jefferson Lab site. The DOD started disposing of the property after closure of the BOMARC missile base in 1963. Some land was conveyed to the Commonwealth of Virginia, NASA (110 acres), and others. In January 1987, ownership of the 110 acres of NASA property, including 100 acres of wooded, undeveloped land, was conveyed to the DOE. An additional 52 acres of land were transferred to the DOE from various sources. At this time, the total DOE-owned parcel, upon which Jefferson Lab is built, is 162 acres.

An adjacent 44 acres, owned by the city of Newport News, were conveyed to SURA in December 1986. A SURA dormitory is located on a portion of this land, and is used by guests and visiting experimenters, who are referred to as users.

Sign at Main Entrance to Site

Exhibit 2-1
Jefferson Lab Vicinity Plan

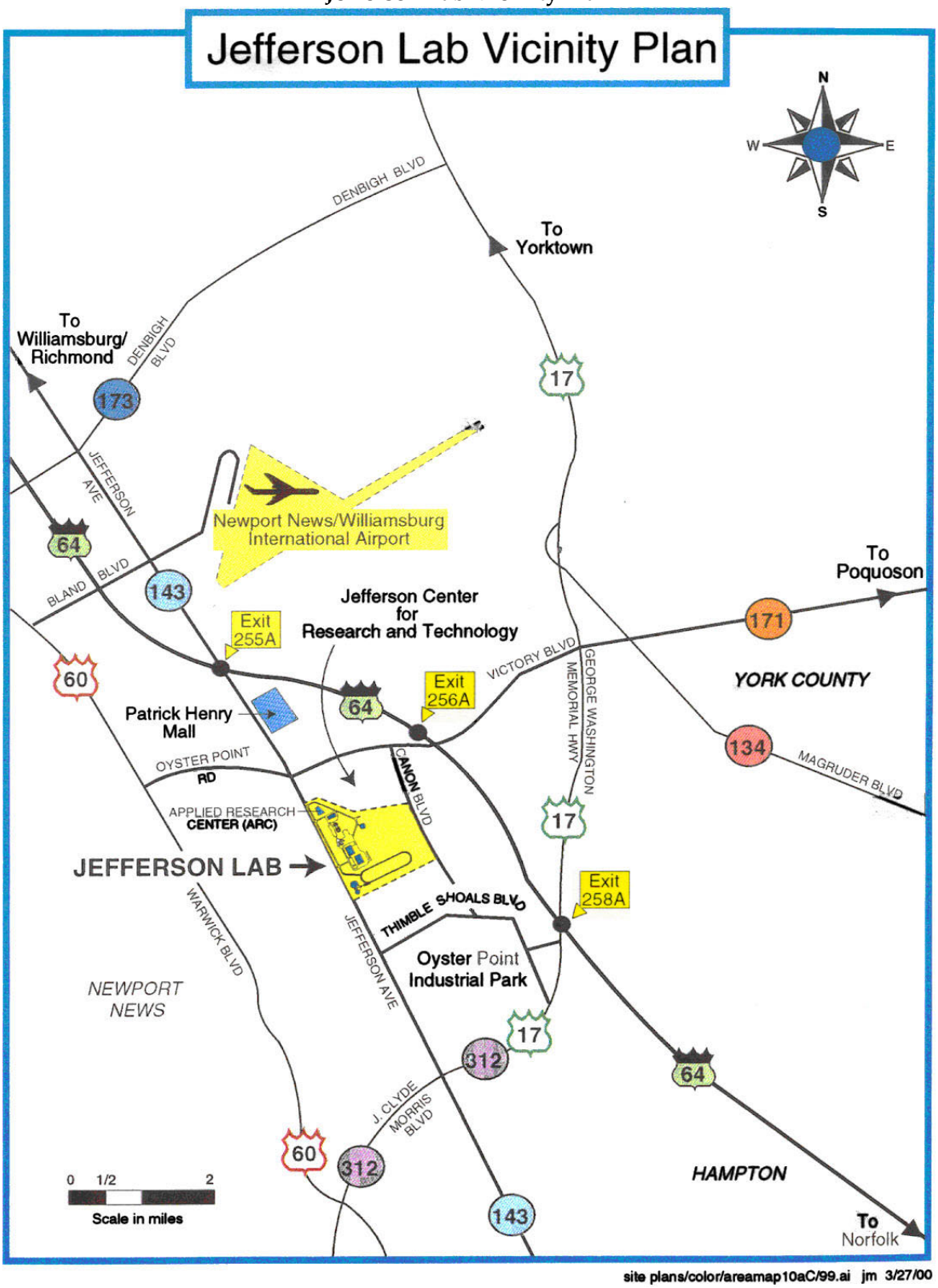
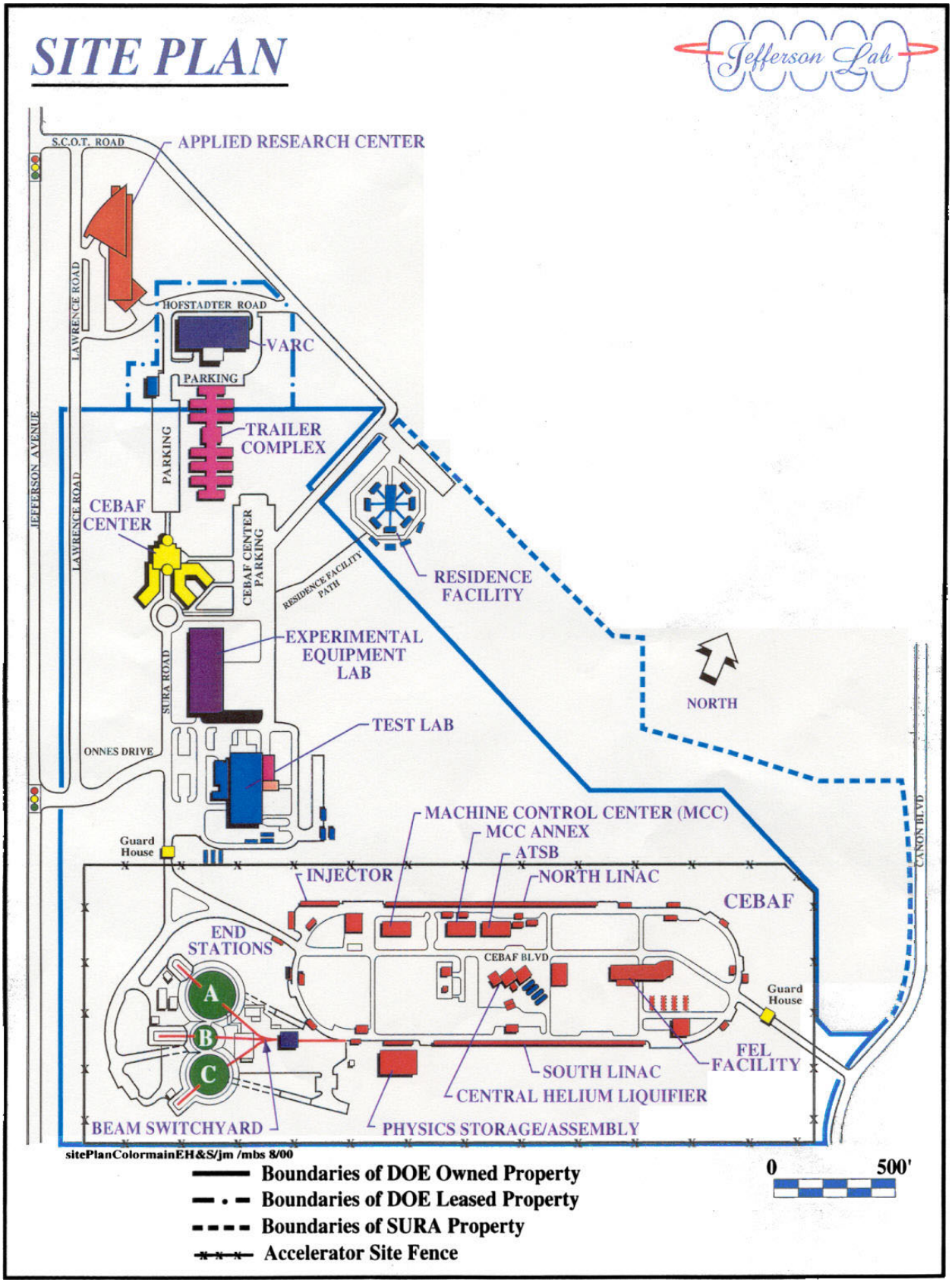


Exhibit 2-2
Site Plan



Also adjacent to the DOE-owned site is a 10.7-acre parcel owned by the Commonwealth of Virginia and leased to the city of Newport News. The Applied Research Center (ARC), located on this property, was completed in 1998. The ARC is used by Jefferson Lab, industry, and universities and is the cornerstone of the newly designated Jefferson Center for Research and Technology. Other adjacent land owned by the Commonwealth of Virginia is leased to SURA and the DOE for its use in support of Jefferson Lab.

Applied Research Center

2.6 SITE ENVIRONMENT, HEALTH, & SAFETY RESOURCES

The facility makes available a variety of EH&S resources to serve the Jefferson Lab community. The Lab community includes staff, Commonwealth employees, subcontractors, visiting experimenters, and students of all ages that participate under various programs.

Local EH&S resources include: EH&S staff that support specific line organizations; EH&S program specialists that serve the entire facility in their area of expertise; groups and committees that address Lab-wide concerns, develop policy, and resolve selected issues; and, the Jefferson Lab EH&S Manual, as the primary source of implementing procedures for EH&S. The EH&S Manual is accessible via paper copy at designated locations or at http://www.jlab.org/ehs/manual/EHSbook.html.

Other EH&S resources available to program managers at Jefferson Lab include: DOE subject matter experts, generally through the DOE Site Office and the Oak Ridge Operations (ORO) Office; DOE program specialists that deal with policy issues at all levels; and colleagues at other DOE facilities that share expertise and lessons learned from their own unique experiences. These resources were utilized in 2001 to support the continued development and implementation of environmental protection and public health-related programs at Jefferson Lab.

SECTION 3
COMPLIANCE SUMMARY

3.1 INTRODUCTION

Compliance with applicable environmental protection and public health-related laws and regulations is an important part of operations at Jefferson Lab.

Assurance that on-site processes do not adversely affect the environment is achieved through Jefferson Lab's self-assessments, routine inspections, and oversight by the DOE Site Office and outside regulators, including staff from the DEQ and HRSD. Assurance is also obtained through guidance from the DOE ORO Office, with additional program support by the DOE Office of Science.

3.2 ENVIRONMENTAL PROTECTION AND PUBLIC HEALTH REQUIREMENTS

Environmental protection (EP) and public health-related requirements are identified in the DOE/SURA contract. They are divided into three groups:

- the Work Smart Standards (WSS) Set;
- the Administrative Laws and Regulations (AL&R); and,
- other contractual commitments.

These requirements that include all relevant environmental protection and public health-

related obligations are described in the appendix.

3.3 WASTE MANAGEMENT STANDARDS

Waste streams at the Lab include hazardous, low-level radioactive, and medical wastes (discussed below). The Lab endeavored to reduce waste generation in 2001 and did make progress in some areas. Though waste reduction considerations are taken into account, new actions, including the commencement of special processes and the addition and use of more experimental and support equipment often involve identifying older materials and equipment that are no longer needed. The Lab has issued waste minimization mandates to reuse or recycle old or discarded materials wherever possible. (Refer to site-specific recycling program information in Section 4.5.3.)

There have been neither waste management activities associated with spills or cleanup actions under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) nor have there been any waste storage or management actions that involved NEPA authorizations.

3.3.1 Hazardous Waste under RCRA, related VA Regulations, and EH&S Manual Chapter 6761, *Hazardous Waste Management*

40 CFR Subchapter I, *Waste Programs*, implements the Resource Conservation and Recovery Act of 1976 (RCRA), also called the Solid Waste Disposal Act (SWDA). RCRA covers waste management and the promotion of "Resource Recovery and Reuse". The Act promotes the protection of health and the environment and the conservation of valuable material and energy resources.

RCRA further provides EPA's authority to regulate solid waste, from minimization and recovery to collection and disposal. The EPA has delegated authority to the DEQ to regulate solid wastes that include hazardous waste. As such, the Virginia Waste Management Act and regulations under the Virginia Administrative Code Sections 9 VAC 20-80, et seq. (*Waste Regulations)* apply. Requirements for safe storage, transport, treatment, and disposal of hazardous waste for generators, transporters, and owners and operators of hazardous waste treatment, storage, and disposal facilities are implemented through the Jefferson Lab EH&S Manual.

Jefferson Lab has been registered as a RCRA Small Quantity Generator (SQG) since 1987. Note that SQGs are not required to file a biennial report to the DEQ. To maintain SQG status, a facility cannot generate more than 1 kilogram (kg) of acutely hazardous waste and 1000 kgs (about 2200 pounds or about 300 gallons maximum) of hazardous waste in any given month, and the facility must not accumulate more than 6000 kgs of hazardous waste on-site at any given time. Jefferson Lab generated about 4300 kgs of hazardous waste in 2001. The hazardous wastes generated in the largest volumes in 2001 were waste buffered chemical polish (an acid mixture) used for niobium cavity processing and waste solvents (acetone, methanol, and isopropanol) from cleaning operations. Hazardous waste minimization initiatives, including improving the review of chemicals being purchased, were implemented in 2001. The most recent DEQ inspection of this program was performed in August 1999.

The Jefferson Lab Hazardous Waste Coordinator (HWC) manages the site program and follows the guidance in EH&S Manual Chapter 6761 to maintain compliance. Hazardous wastes are temporarily stored at Jefferson Lab; however, no permitting is required because the wastes are properly disposed of within the regulatory time frame. Jefferson Lab neither transports hazardous wastes nor operates any regulated treatment or disposal units. All wastes are disposed of through licensed waste handling facilities. There are two elementary neutralization units, but they are not regulated as treatment devices. Some environmentally harmful materials (EHMs) are recycled and/or reused prior to final disposal. Full

compliance with the listed requirements was maintained through 2001.

3.3.2 Low-Level Radioactive and Mixed Waste under DOE Order 435.1 and the AEA

The Radiation Control (RadCon) Group implemented the applicable sections of DOE Order 435.1, *Radioactive Waste Management,* in 2001. A program to enable more efficient separation and categorization of the Lab's low-level radioactive wastes (LLW) was established in 2001, which resulted in the identification of more waste than would normally be expected in a year. As there is no waste generated that carries either the source materials or special nuclear materials subject to the Atomic Energy Act of 1954 (AEA), as amended, its conditions are not applicable.

Roughly 42 cubic meters of LLW were disposed of in FY 2001. This rather large amount of waste was not generated solely in 2001 but had been slowly generated since the first test beams were produced in 1992. For the first time at Jefferson Lab, accumulated radioactive waste was turned over to a certified subcontractor for disposal in August 2001. A permit, No. 4727-45-01, to transport waste within South Carolina, was obtained in 2001.

Though Jefferson Lab is required to follow the RCRA requirements that apply to mixed waste, which exhibits both hazardous and radioactive characteristics, there has been no mixed waste generated to date. Jefferson Lab was in compliance with all applicable standards in 2001.

3.3.3 Non-Hazardous Waste under DEQ Standards and the EH&S Manual

Non-hazardous wastestreams generally contain non-regulated chemical wastes, non-recyclable office and production waste materials, and debris resulting from construction activity. The DEQ is responsible for regulating such waste programs. Jefferson Lab line management is responsible for proper administration of the wastestreams covered under this category according to EH&S Manual Chapter 6760, *Waste Management*.

3.3.4 Other Non-Hazardous Waste-Related Compliance Items under RCRA

There are other forms of liquid and solid non-hazardous wastes, including domestic wastewater. Two water collection sump pits are located in the Counting House (Building 97), with one pit discharging to surface water and the contents of the other pit being pumped to the HRSD system. The permits for these water discharges are discussed in Section 3.6.2. Other non-hazardous wastes are disposed of in a landfill, reused on-site, recycled, or used for other purposes offsite. Approved waste management plans and procedures prevent or minimize impacts to the environment, both at the generating facility and at the final usage or disposal point. Jefferson Lab minimizes the generation of waste (source reduction) as the primary means of reducing environmental impacts, thereby lowering purchase and disposal costs.

The Lab utilizes licensed subcontractors for collection, separation, and permanent disposal (aluminum cans and paper goods are recycled separately). Section 3.10.2 refers to Performance Measure results for tracking recyclables.

3.3.5 Regulated Medical Waste under the EH&S Manual

The Lab's EH&S Manual Chapter 6850, *Regulated Medical Waste Management* and Appendix 6850-T1, *Regulated Medical Wastes Handling Procedures,* apply and include RCRA and Virginia requirements. There were no compliance issues with this program in 2001.

3.3.6 Federal Facility Compliance Act

This Act, which amends the SWDA, gave the EPA authority to enforce actions against branches of the Federal government for violation of Federal, State, interstate, or local solid or hazardous waste regulations. There were no compliance issues at Jefferson Lab during 2001.

3.3.7 Toxic Materials under TSCA

The Toxic Substances Control Act (TSCA) and its implementing regulations, 40 CFR Subchapter R, require that specific chemicals such as polychlorinated biphenyls (PCBs) and asbestos be controlled and their use restricted.

PCBs

Since 1987, SURA has been removing PCBs and PCB-contaminated items from the site. Technically, the site is PCB-free. There were no compliance issues in 2001.

Asbestos

Most asbestos-containing material (ACM) was removed from the site prior to 1992. In July 1992, an Asbestos Management Plan identified the remaining ACMs in Buildings 28 and 58 as non-friable and in fair to good condition; therefore, abatement is not required by current regulations.

Jefferson Lab complies with the training requirements identified in the Asbestos Hazard Emergency Response Act of 1986 (Title II of TSCA) and the emission control requirements in NESHAPs. EH&S Manual Chapter 6681, *Asbestos Management,* implements the ACM requirements at Jefferson Lab. There were no compliance issues in 2001.

3.3.8 FIFRA

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) applies to the storage and use of herbicides and pesticides at Jefferson Lab. The application of herbicides and pesticides is permitted through a State-administered certification program, accomplished by certified subcontractors who comply with FIFRA through Virginia's program. All pesticides used in 2001 were EPA-registered and applied according to the product instructions and Federal, State, and local guidelines. Jefferson Lab's Plant Engineering Department subcontracts monthly preventive pest control.

Herbicides were used on annual and perennial weeds and grasses, stumps of trees, and brush. Pesticides were applied on-site for control of insects. Areas addressed included kitchens, laboratories, and other areas throughout the site. No industrial-strength herbicides or pesticides are prepared, mixed, stored, or disposed of on Jefferson Lab property. The subcontractor is responsible for handling any waste disposal through an authorized disposal facility. Small containers of household pesticides are stored on-site and applied per manufacturer's recommendations. Pesticides and herbicides that were approved for use in 2001 are presented as Exhibit B1 in the appendix. There were no FIFRA compliance issues at Jefferson Lab in 2001.

3.4 RADIOLOGICAL PROTECTION REQUIREMENTS

This section summarizes Jefferson Lab's compliance with radiological EP and public health requirements.

3.4.1 Title 10 - Energy

10 CFR 71, Packaging & Transportation of Radioactive Material

Jefferson Lab made its first shipment of radioactive waste in 2001. RadCon completed the loading and surveying of the shipping containers and turned over disposition of the waste to the waste broker in July. The broker took physical possession of the waste in early August and transported the material off the site. There were no compliance issues in 2001. (Additional transportation compliance information is provided in Section 3.8.4.)

10 CFR 834 (Draft) Environmental Radiological Protection Program

Programs responsive to offsite radiation protection and other 10 CFR 834 (Draft) requirements have been instituted. Implementation measures have been incorporated into the EH&S Manual chapters discussed in Section 3.4.3 below.

10 CFR 835, Occupational Radiation Protection

The Price-Anderson Amendments Act (PAAA) of 1988, including the 1992 amendment, was enacted to provide broad indemnification coverage for DOE

contractors with worker radiological-related activities and requires reporting of non-compliances. DOE PAAA worker radiation protection regulations are codified in 10 CFR 835 and address: radioactive contamination, storage of radioactive materials, and radiological emergency response.

Jefferson Lab made a worker radiation protection report in the PAAA notification system following an August 2001 event, which involved having an unposted high radiation area for a short period in the Test Lab (Building 58). No worker radiation exposure resulted and no actual or potential environmental impacts were associated with this event. Test Lab staff have resolved the interlock problem that created the short duration radiation event. No other 10 CFR 835 compliance issues occurred in 2001.

3.4.2 Title 40, Part 61, Subpart H

This subpart, the National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities, sets an annual public dose limit for radionuclide emissions. The Lab complied with 40 CFR 61 Subpart H requirements. There were no compliance issues in 2001. Refer to Section 3.5.2.1 for more information.

3.4.3 EH&S Manual Chapters 6310 and 6315

Chapters 6310, *Ionizing Radiation Protection,* and 6315, *Environmental Monitoring of Ionizing Radiation,* describe site programs for offsite radiation protection, storage of radioactive materials, emergency response, and release of materials to uncontrolled areas. Chapter 6315 addresses radiological air emissions, surface water, and radioactive contamination of other water-containing systems and groundwater. There were no compliance issues in 2001.

3.4.4 DOE Order 5400.5

Applicable sections of DOE Order 5400.5, *Radiation Protection of the Public and the Environment,* are implemented by Jefferson Lab's Radiological Control (RADCON) Manual. There were no compliance issues in 2001.

3.5 AIR QUALITY AND PROTECTION STANDARDS

The Clean Air Act (CAA) and its 1990 Amendments (CAAA) regulate the air emissions of DOE's processes and facilities. The DEQ, as delegated by the EPA, issues permits for owners and operators of stationary sources that could emit threshold amounts of fugitive dust, odor, or other designated pollutants. At this time Jefferson Lab has no processes that require air permitting.

Applicable regulations are contained in 40 CFR Subchapter C, and in Virginia's 9 VAC 5 series, *Air Quality*. Standards include EO 13148 and EH&S Manual Chapter 6720, *Air Quality Management*.

3.5.1 National Ambient Air Quality Standards (NAAQS)

Under the authority of the CAAA, the EPA has established NAAQS for sulfur oxides, particulate matter, carbon monoxide, ozone, nitrogen dioxide, and lead. The Hampton Roads area, which includes Newport News, remained in attainment for all NAAQS pollutants in 2001, but continues as a maintenance area for ozone.

Jefferson Lab complies with all Commonwealth ambient air quality requirements. The Lab leases its vehicles through the General Services Administration (GSA) and vehicle maintenance is performed offsite by GSA-approved facilities. There is no gasoline dispensing facility on-site, but there is one diesel fuel tank for forklifts. Subcontractors operating machinery may have temporary diesel fuel storage tanks with secondary containment basins. There were no compliance actions under Title I of the CAA in 2001.

3.5.2 NESHAPs

NESHAPs governs air emissions that contain hazardous components (such as radionuclides or asbestos). The EPA administers the radionuclide portion of this

program in Virginia. Jefferson Lab began "operations" as defined by NESHAPs in October 1995.

3.5.2.1 Radionuclide Emissions

Radionuclide emissions generated during accelerator and FEL testing and operations, including emissions resulting from interactions of the accelerator beam with experimental targets and physics research equipment, fall under NESHAPs. DOE-owned facilities which emit radionuclides to the air are required to sample, monitor, and assess dosage per the NESHAPs requirements in 40 CFR 61 Subpart H and report to the EPA as applicable. (Refer to Section 5.3.1 for discussion of direct radiation, the primary form of radiation generated on-site.)

Jefferson Lab used sampling results and calculations to demonstrate that the Lab remained under the EPA-defined 10 mrem/yr potential effective dose equivalent to any member of the public during 2001. As effluent concentrations are below monitoring thresholds, routine monitoring of radioactive airborne effluents at the site boundary is not required. However, the Lab does make periodic confirmatory measurements to verify low emissions.

Currently, no major radiological NESHAP point sources, such as stacks or vents, exist at Jefferson Lab that meet the 40 CFR 61.93(b) threshold monitoring criterion of 1% of the 10 mrem/yr. Consequently, continuous point source monitoring is not required.

Since no EPA-reportable radiological or non-radiological air emissions have occurred in previous years, Jefferson Lab had a reporting exemption under this Subpart. Based on common DOE laboratory practice, even among DOE facilities that are under the reporting threshold, Jefferson Lab voluntarily furnishes an annual report to the EPA. This is discussed further in Section 5.3.1. No notifications for construction or modifications were necessary in 2001.

3.5.2.2 NESHAP Asbestos Removal

While the NESHAP standard does not set a numerical threshold for asbestos fiber emissions, it requires those conducting asbestos-related activities, such as demolition and renovation, to follow approved procedures and to adopt specific work practices to prevent release of asbestos to the air. Regulations require that licensed, trained personnel perform any work with no asbestos-related NESHAP issues in 2001. Compliance with other asbestos standards is described in Section 3.3.7.

3.5.3 Non-radiological Emissions

Under the Virginia Regulations for the *Control and Abatement of Air Pollution* (9 VAC 5-10 et seq.), Jefferson Lab is required to notify the DEQ of sources of potential air pollution. Jefferson Lab minimizes releases of polluted air by preventive maintenance and scrubbers. The Lab's air emissions remain below reporting thresholds as there were no new emission sources installed in 2001.

Jefferson Lab has seven natural gas-fired boilers and a fin-tube radiator for building heating. Boiler information, including fuel consumption data, is provided to the DEQ. For more information, refer to Section 6.2. No requirements for permits are anticipated. The last DEQ inspection occurred in September 2000, with no concerns identified. There were no air emission violations at Jefferson Lab in 2001.

3.5.4 Stratospheric Ozone-Depleting Substances (ODS)

Executive Order (EO) 13148, *Greening the Government through Leadership in Environmental Management,* reinforced federal agency commitments to use safe, cost-effective, environmentally preferable alternatives to ODSs. The ODS substances that have been used at Jefferson Lab include refrigerants, degreasers, cleaners, spray can propellants, and fire suppressants. The phase out of these substances will have a moderate impact on the site.

Section 608 of Title VI of the CAAA, *National Recycling and Emission Reduction Program,* prohibits intentional venting of Class I and Class II compounds from air conditioning and cooling units. Jefferson Lab has one recovery machine, a National Reference Products Model MINILU (for R-12, 22, 502, and 134a) on-site. Also, the subcontractor who performed all service, repair, and maintenance on Jefferson Lab refrigeration/air conditioning equipment during 2001, was EPA-certified and effectively captured and recycled these ODS compounds. Four Jefferson Lab Plant Engineering employees have received certification training, ensuring that Lab staff understand the EPA requirements.

Jefferson Lab has three chlorofluorocarbon (CFC)-based chillers on-site, one uses R-11 and two use R-113. They are effectively maintained by mechanical staff to ensure optimal performance and minimal CFC losses. There were various releases from June to August at another unit that uses R-22. These releases totaled approximately 360 pounds before repairs were completed in August. Opportunities to modify or replace these units were explored in 2001, but the existing units presently meet Jefferson Lab needs.

The site will phase out use of CFCs to the extent possible. R-12, however, is the highly preferred material for use in some physics experiments but there are no State or Federal regulations that address the small amounts of R-12 involved. Halon 1211 is stored in the experimental halls for use as a fire-extinguishing agent of last resort to protect certain types of specialized equipment. The Halon is contained in manually operated fire extinguishers, with hall staff trained in precautions and use.

Section 609 of the CAAA lists the requirements for the *Servicing of Motor Vehicle Air Conditioners*. All vehicle air conditioning units are serviced offsite by shops approved by the GSA.

Jefferson Lab is committed to minimizing and/or eliminating the use of ODSs. The Lab's CFC and Halon Use Policy is included in the EH&S Manual Appendix 6720-T2, *Air Quality Program Regulatory Requirements*.

3.6 WATER QUALITY AND PROTECTION STANDARDS

Both groundwater and surface water protection are high priorities at Jefferson Lab. Applicable standards include: the Clean Water Act (CWA); Virginia's *State Water Control Law*; regulations that include parts of 40 CFR Subchapter D and Virginia's 9 VAC 25 Series, *Water Quality*; site permits; and, cited EH&S Manual chapters. Each of these standards is referenced under the respective topic below.

Facilities in Virginia that directly discharge to waters of the United States must obtain a Virginia Pollution Discharge Elimination System (VPDES) permit to do so. The VPDES program is designed to protect surface waters by limiting primarily non-radiological releases of effluents into streams, lakes, and other waters, including wetlands. Regulatory and program concerns relating to construction and industrial activities, including the potential for radiological contamination of groundwater and the quality of cooling water discharges, are discussed in Section 3.6.1 below.

The concrete halls, which house the experimental apparatus that accepts accelerator beam, are partially buried. As the floors of the halls lie below the water table, a built-in drainage system was installed under each of the halls to prevent the structures from floating. Groundwater collects in this drainage system and is pumped to a surface water channel (a process termed *dewatering)*. Compliance with the related permits is described in Sections 3.6.1 and 3.6.2.

Jefferson Lab has a variety of on-site activities that result in water discharges to the sanitary sewer system. Other associated wastewater standards included in the WSS Set are discussed in Section 3.6.2.1.

There is a significant aggregate quantity of oil present on the site, primarily in transformers and compressors that are in continual use. Consequently, Jefferson Lab has a Spill

Prevention, Control, and Countermeasure (SPCC) Plan that is discussed further in Section 3.6.2.3.

3.6.1 VPDES Permits

3.6.1.1 Construction Activity

Jefferson Lab strives to keep pollutants, such as sediments, out of surface waters during earth disturbing activities. No VPDES permits involving construction have been required through 2001. The Lab's Plant Engineering Department oversees the civil construction and ensures that subcontractors adhere to the standards set forth in the *Virginia Erosion and Sediment Control Handbook*. EH&S Manual Chapter 6733, *Storm Water Pollution Prevention,* identifies the site program to address erosion control during earth-disturbing activities.

3.6.1.2 Industrial Activities

Groundwater Monitoring - VPDES Permit No. VA0089320

This permit covers groundwater resources, including groundwater flowing across the site and groundwater discharged in the dewatering operation (refer to Section 3.6.2.2). An earlier DEQ permit quantified water quality "baseline" values for certain parameters and set long-term groundwater quality limits. A well monitoring program under the current permit enables the comparison of current and "baseline" values. Jefferson Lab verifies that accelerator operations and other activities, such as groundwater dewatering, do not degrade the quality of either on-site or offsite groundwater. Refer to Section 7 and EH&S Manual Chapter 6731, *Groundwater Protection,* for additional information.

Throughout 2001, groundwater sampling to monitor all permit-defined parameters was performed under a subcontract with an accredited laboratory and submitted to the Commonwealth at the end of each quarter. There were no compliance issues involving groundwater in 2001.

Cooling Water Discharges - General Permit No. VAG253002

This Permit, which contains water quality limits, covers the surface discharges from the cooling towers adjacent to the Central Helium Liquifier, Building 8. A small tower adjacent to the Test Lab, Building 58, was added to the Permit in early 2001.

Sampling is performed under a subcontract with an accredited laboratory and is submitted to the Commonwealth at the end of each quarter. Sampling during 2001 revealed one unusual result for chlorine. During the fourth quarter the chlorine level at one sampling site was above the non-detect level, though below the water production utility's maximum chlorine residual levels. There was no known explanation (e.g. there were no water treatment chemicals in use that could have contributed to the chlorine level); however, the elevated value may stem from large city water leaks that occurred around that time.

3.6.2 Other Water Program Standards in the WSS Set

3.6.2.1 Industrial Wastewater

40 CFR 403, General Pretreatment Regulations for Existing and New Sources of Pollution

This regulation contains National Pretreatment Standards for pollutants that pass through or interfere with offsite treatment processes. Jefferson Lab's sanitary sewage is discharged to an offsite publicly owned treatment works operated by the HRSD. The Lab is categorized as a Non-significant Industrial User with no pretreatment requirements. In 2001 the Lab received an HRSD Gold Award for having no violations.

Industrial Wastewater Discharge Permit No. 0117 and the District's Industrial Wastewater Discharge Regulations (IWDR)

Discharges to the HRSD are subject to the Industrial Wastewater Discharge

Permit and the IWDR. EH&S Manual Appendix 6730-T1, *Discharges to the Sanitary Sewer System,* presents implementation practices at Jefferson Lab.

Quarterly pH values are recorded by a subcontractor at prescribed sampling points and provided to the HRSD. HRSD independently performs regular sampling for metals and other water quality indicators at some of the sampling points to validate Jefferson Lab's compliance with permit and regulatory requirements. There were no violations or disparities in 2001.

Permitted discharges of activated water at one HRSD sampling point continued in 2001. Discharges are controlled manually, after sampling has confirmed that all values are within identified limits. Either Jefferson Lab staff or a subcontractor performs monthly and quarterly radiological analyses from this sampling point and the analytical reports are provided to the HRSD. All radiological permit and regulatory criteria were met in 2001 and are discussed further in Section 5.3.2.

To illustrate the relative quantity of radioactivity being discharged, the Lab is permitted to discharge no more than 5 Ci (Curies) of tritium and 1 Ci of other gamma-emitting radionuclides in one year. The total radioactivity discharged to the sanitary sewer in 2001 was 0.88 Ci of tritium (*or about 17.6% of the total allowed*) and 0.000034 Ci for other gamma-emitting radionuclides (*or 0.0034% of the total allowed*).

Laboratory staff participated in the February 28, 2001 annual inspection by the HRSD - no compliance issues were identified at that time or throughout the course of the year.

3.6.2.2 Permit to Withdraw Groundwater No. GW0030800

To maintain water table levels consistent with the experimental hall structural design, water table control via pumping will be necessary for the life of the facility. This DEQ Permit places monthly and annual limitations on the amount that can be pumped. It is important to note that this type of "no usage" withdrawal is unusual. Groundwater is normally withdrawn for irrigation or drinking water.

Quarterly reporting of withdrawal quantities continued in 2001, and all monthly values were within permit requirements. The total quantity of water withdrawn in 2001 was 4.6 million gallons, which was well below the roughly 23 million gallon annual limit. The Lab voluntarily reports its annual water usage to assist the DEQ in determining total regional water usage.

Permit compliance was maintained in 2001. Water quality sampling, as described above, is performed under the terms of the VPDES Permit No. VA0089320.

3.6.2.3 SPCC Plan – Above Ground Storage Tank Issues

Jefferson Lab has transformers and other operating machinery on-site that use various oils for lubrication, hydraulics, and cooling. The Lab maintains a used oil collection area to assist in managing the resulting used oil. The Lab has an approved SPCC Plan as required by 40 CFR 112, which was reviewed and updated in 2001. The SPCC Plan covers handling, storage, and transportation activities and is implemented by EH&S Manual Chapter 6732, *Oil-Spill Prevention, Control, and Countermeasures*.

There are two oil-storage tanks on-site that meet Federal and State above ground storage tank definitions, but the total quantity stored is under the

notification threshold. There were no compliance issues in 2001. See Section 4.5 for more information on oil-related items.

3.7 COMPLIANCE STATUS - PUBLIC HEALTH STANDARDS

The Safe Drinking Water Act of 1974 (SDWA) ensures that drinking water is safe for public consumption. Compliance is achieved via the EPA's National Primary Drinking Water Regulations that apply to public water supplies. These regulations set maximum contaminant levels on bacteriological, chemical, physical, and radiological contaminants for public water systems.

The Virginia Department of Health regulates drinking water quality and enforces compliance with all Federal and State drinking water-related permits and standards. Jefferson Lab receives its drinking water through three public water supply lines provided by the City of Newport News Waterworks. No monitoring by Jefferson Lab is required.

The SDWA applies to two areas at Jefferson Lab: the Backflow Prevention Program and the surface discharges under the three DEQ permits. Jefferson Lab had no SDWA compliance issues during 2001.

3.7.1 Backflow Prevention

An annual backflow prevention device inspection is required by the city of Newport News and the DEQ on all intra-building main supply connections. This program ensures that untreated industrial wastewater or contaminants from cross-connected chemical processes and building equipment are mechanically prevented from contaminating the drinking water supply. Jefferson Lab engages locally approved plumbing firms to ensure all backflow prevention devices function as designed. Annual inspection reports (the last in June 2001) are sent to the city's Public Utilities Department. No issues have ever been identified.

3.7.2 Surface Water Quality

The site drainage system flows to the Big Bethel Reservoir, a drinking water source for local military installations. The groundwater dewatering discharge, monitored under the VPDES Permit No. VA0089320, and the cooling water effluent, monitored under the VPDES General Permit No. VAG253002, are discharged into surface water channels that lead offsite. Fort Monroe environmental staff are provided annual information on the quantity of groundwater discharged, with information collected under the Permit to Withdraw Groundwater. There were no compliance issues involving surface water quality in 2001. Refer to Sections 4.2.3 and 5.3.2 for further discussion on permit monitoring programs.

3.7.3 Drinking Water Quality

The water quality limits for the groundwater monitoring wells in VPDES Permit No. 0089320 include one value that is one-quarter of the state's drinking water standard. There were no compliance issues regarding wells in 2001.

3.8 OTHER ENVIRONMENTAL STANDARDS

3.8.1 Endangered Species Act (ESA)

The ESA protects endangered wildlife, fish, plants, and their ecosystems. A 1986 environmental survey of Jefferson Lab's 162-acre site uncovered no endangered species in the area. A 2001 threatened and endangered species survey identified no species on the Jefferson Lab property that were either threatened or endangered, or of special concern in Virginia. As such, no ESA compliance issues were identified in 2001.

3.8.2 Migratory Bird Treaty Act (MBTA)

The MBTA of 1918 prohibits any unauthorized taking, possessing, importing, or other listed actions, of any migratory bird or their eggs. The 1987 EA found that 150 avian have ranges that encompass the Jefferson Lab site, including both permanent and summer residents. Because the site lies within a disturbed

industrial and commercial area, only a small fraction of these species are expected to be found on site. A 2001 survey identified no suitable breeding sites for any of the birds noted in 3.8.1 above. There were no concerns involving the MBTA in 2001.

3.8.3 National Historic Preservation Act (NHPA)

The NHPA of 1966, Section 106, protects archaeological and historical resources. Area surveys in 1987 and major construction since that time have uncovered no trace of historic or archaeological resources. On October 16, 1992, the Commonwealth of Virginia's Department of Historic Resources (VDHR) determined that all Section 106 conditions had been met and no further assessments were required. A follow-up with the VDHR was performed during the preparation of an EA in 2001, and identified no concern at that time. The draft EA did note that the VDHR would be notified if anything unusual was encountered during any construction.

3.8.4 Transportation Standards

Transportation-related hazards at the Lab arise as a consequence of the receipt, packaging, and transportation of hazardous and radioactive materials and waste; compressed gases; cleanup materials used in response to on-site spills; and, regulated medical wastes. Many of the regulations applicable to transportation also apply to other environmental or public health topics.

Requirements include the Department of Transportation (DOT) regulations identified in 49 CFR Subchapter C, *Hazardous Materials Regulations*; the Jefferson Lab RADCON Manual; EH&S Manual Chapters 6150, *Compressed Gases,* 6310, *Ionizing Radiation Protection,* Appendix 6750-T4, *Packaging EHMs for Transport*; and, identified industry standards. Compliance with some of these standards is addressed below or under the SER section listed in Exhibit A4 of the appendix.

49 CFR Regulations

49 CFR 171 through 178 cover hazardous and radioactive materials transportation and contain DOT packaging and transport requirements to protect the environment or public health in case of accidents. The delivery of hazardous or radiological materials to the site is contingent upon compliance with appropriate DOT and other requirements. Hazardous and radioactive materials must be properly packaged for offsite transport according to DOT regulations. RadCon manages the radiological portion of this program and the HWC manages non-radiological DOT requirements. There were no compliance issues in 2001.

EH&S Manual Chapters 6150, 6310, 6750, and 6850; RADCON Manual; and, Handbook of Compressed Gases

These requirements provide for the safe packaging and transport of hazardous and radioactive materials on Jefferson Lab property. Properly trained staff perform on-site transport of hazardous materials in accordance with the EH&S Manual as noted in Section 3.8.5. The RadCon Group, in accordance with the Jefferson Lab RADCON Manual and other internal procedures, manages radioactive materials. All medical wastes are handled by specially trained staff and managed by Medical Services. There were no compliance issues regarding these transportation standards in 2001.

3.8.5 Environmental Protection Standards

The Lab EHM program is identified in EH&S Manual Chapter 6750, *Environmentally Harmful Materials,* and its appendices. The objective is to prevent spills or unintentional releases. Protection measures include secondary containment and the location of EHM storage areas away from floor drains. Though there were four minor oil spills, there were no uncontrolled EHM releases affecting the environment or public health in 2001.

3.9 EXECUTIVE ORDERS AND POLLUTION PREVENTION (P2)

The following EOs, discussed below, primarily address P2 strategies: EO 13101, *Greening the Government through Waste Prevention, Recycling and Federal Acquisition*; EO 13123, *Greening the Government Through Efficient Energy Management*; and EO 13148, *Greening the Government through Leadership in Environmental Management*. Information on the applicable Pollution Prevention Act (PPA) of 1990 is included in the discussion under EO 13148.

3.9.1 EO 11988 "*Floodplain Management*"

This EO relates to the occupancy and modification of floodplains. Since Jefferson Lab is not in a 100-year floodplain, the specific EO 11988 requirements do not apply; however, localized flooding during significant rain events, including hurricanes, does occur. Plant Engineering coordinates drainage modifications to ensure appropriate drainage is maintained.

3.9.2 EO 11990 "*Protection of Wetlands*"

This EO ensures that adverse impacts to wetlands from construction activities are avoided or responsibly mitigated. During original site investigations, the Corps of Engineers determined that the forested temporary wetlands to be disturbed by the construction of Jefferson Lab were not sufficiently permanent to qualify as wetlands, and, therefore, did not require the protection specified by EO 11990.

EO 11990 and 10 CFR 1022, *Compliance with Floodplain/Wetlands Environmental Review Requirements*, contain notification requirements to be considered when proposing new work beyond the scope of the original site EA and FONSI. Evaluation of Jefferson Lab activities involving potential wetlands is accomplished through the NEPA review process. A 2001 survey found no wetlands at any of the sites proposed for construction projects in a draft 2001 EA. There were no concerns involving wetlands in 2001.

3.9.3 EO 13101 "*Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition*"

EO 13101 encourages agencies to make more efficient use of natural resources by recycling and practicing waste prevention measures. This is accomplished in part by promoting the procurement of products made with recycled materials, termed Affirmative Procurement (AP), by federal agencies. The purchase of these materials helps "close-the-loop" in the recycling process. To comply with this EO, the DOE has set goals and performance standards on a variety of product classes. The DOE's complex-wide FY 2001 procurement target for purchasing EPA-listed products was 100%. Jefferson Lab's compliance level was 84.0% for FY 2001, a major improvement from the 58.2% reported in FY 2000. Refer to Section 4.2 for more information on this topic.

3.9.4 EO 13123 "*Greening the Government Through Efficient Energy Management*"

This initiative, effective November 4, 1999, focuses on energy efficiency (E2) as a means of pollution prevention. The DOE seeks a long-term energy use reduction of 15% for buildings and industrial facilities - a 7% reduction was documented in FY 2000. Plant Engineering analyzed buildings and their support systems in 2001 to look for ways to reduce energy consumption in the long term. Information on site-specific goals developed in response to the Secretary of Energy's P2 and E2 initiatives in early 2001 is provided in Section 3.9.5.6.

3.9.5 EO 13148 "*Greening the Government Through Leadership in Environmental Management*"

EO 13148 integrates environmental accountability into federal agency policies, operations, planning, and management. The primary P2 goal is that pollution should be prevented or reduced at the source. Jefferson Lab complies with Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) requirements, uses only a few toxic

chemicals, and complies with the other requirements of this EO to the extent practicable.

The Lab's compliance with EPCRA is presented in Section 3.9.5.1. Section 3.9.5.2 reports how Jefferson Lab uses P2 and other activities to maintain environmental compliance. Specific Lab P2 and E2 initiatives are discussed in Section 4.5.5. The results from environmental compliance reviews are provided in Section 3.9.5.3. Section 3.9.5.4 reports on progress in implementing environmentally beneficial landscaping practices. Results from DOE's EMS self-assessment questionnaire are provided in Section 3.9.5.5, and a summary of the Lab's progress in meeting DOE and site-identified goals is presented in Section 3.9.5.6.

As stated, Jefferson Lab is committed to being environmentally accountable through day-to-day decision-making and long-term planning processes, across all missions, activities, and functions.

3.9.5.1 EPCRA Compliance

EPCRA, also known as the Superfund Amendments and Reauthorization Act (SARA) Title III, created a system for planning responses to emergencies involving CERCLA hazardous substances (HSs) and EPCRA extremely hazardous substances (EHSs). EPCRA requires that information regarding the use and storage of these hazardous chemicals be made available to the public. This is done through reports to the EPA (which posts some information on their website) and local response agencies. Jefferson Lab is responsible for planning and responding to chemical emergencies as well as completing applicable reporting requirements as noted in Exhibit 3-1.

The Commonwealth of Virginia Emergency Response Council administers the EPCRA program for the EPA. Local emergency response agencies that serve Jefferson Lab are the Peninsula Local Emergency Planning Committee and the City of Newport News Fire Department. Transportation-related standards pertaining to emergency planning are discussed in Section 3.8.4.

Besides EO 13148, other EPCRA-related planning and prevention standards that apply to Jefferson Lab include: 40 CFR 300, 355, 370, and 372 (provide regulatory compliance guidance - see specifics below); and Appendix 6710-T2, *Emergency Planning and Community Right-to-Know.*

Exhibit 3-1
EPCRA Reporting Status

EPCRA Section	Description of Reporting	Status
EPCRA Sec. 302	Planning notification	Yes
EPCRA Sec. 303	Comprehensive Emergency Response Plans	Not applicable
EPCRA Sec. 304	EHS Release Notification	No reporting required to date
EPCRA Sec. 311-312	MSDS/Chemical Inventory	Yes, provide 312 annually
EPCRA Sec. 313	TRI Reporting	No reporting required to date

Emergency Planning Standards 40 CFR 300, National Oil and Hazardous Substances Pollution Contingency Plan (NCP)

This regulation primarily addresses DOE's role in the NCP. Jefferson Lab complies with 40 CFR 300 by having emergency response procedures in place to respond to oil and hazardous substance releases, as identified in EH&S Manual Chapters 3510, *Emergency Management Plan,* and 6732, *Oil-Spill Prevention, Control, and Countermeasures.*

EPCRA Section 302, Emergency Planning and Release Reporting

Under EPCRA Section 302, (refer to 40 CFR 355) Jefferson Lab is required to notify the Commonwealth and local emergency planning and response groups (EPGs) within sixty days of the receipt of an EHS that exceeds the Threshold Planning Quantity (TPQ). Jefferson Lab's EPCRA Section 302 notifications to date include hydrofluoric acid, nitric acid, and bromine. There were no new EHSs identified in 2001.

Jefferson Lab is also required to notify the Commonwealth and local EPGs of accidental offsite releases of any HS listed under CERCLA or any EHS listed under EPCRA. The release levels that trigger the EPCRA Section 304 notification requirements are the reportable quantity (RQ) values listed in the regulations for each substance. Jefferson Lab has had no releases that meet identified reporting criteria to date. (For discussion about the permitted release of activated water to the sanitary sewer system, refer to Section 3.6.2.)

EPCRA Sections 311 and 312, Hazardous Chemical Inventories

Under EPCRA Sections 311 and 312, Material Safety Data Sheets (MSDSs) (refer to 40 CFR 370), or a list of those chemicals, must be submitted to EPGs for each hazardous chemical that exceeds the TPQ identified in the regulations. Inventory information is obtained through an annual sitewide chemical inventory coordinated by the Jefferson Lab Industrial Hygienist. Jefferson Lab's submittal of the annual Tier II Report, a hazardous chemical inventory form, to the EPGs satisfies this reporting requirement. Refer to Exhibit 3-2 for the list of chemicals reported for 2001.

Exhibit 3-2
Chemicals Reported for 2001

Compound	Hazard Class				
	Fire	Sudden Release of Pressure	Acute Health Hazard	Reactive	Chronic Health Hazard
Argon (liquid)		√	√		
Helium (liquid		√	√		
Nitrogen (liquid)		√	√		
Nitric Acid			√	√	
Hydrofluoric Acid			√	√	
Hydraulic Oil (Various including vacuum oil)	√				√
Lead (Sheeting)					√
Bromine				√	√

Helium Container Near Building 98

Additional information is provided upon request. The 2001 EPCRA 312 report submittal included updating site contact information and verifying Peninsula Local Emergency Planning Committee records. In addition, upon request, the Lab's Emergency Management Manager provides MSDSs to the local Fire Chief for their records.

Chemical Inventory

EPCRA Section 313, Toxic Release Reporting

This section (refer to 40 CFR 372) requires the submission of information to the EPA relating to the release of toxic chemicals, including an annual toxic chemical release report, the Toxic Release Inventory (TRI), by any facility that manufactures, imports, processes, or otherwise uses more than a threshold amount of any of approximately 360 EPA-identified toxic chemicals. Jefferson Lab does have "otherwise use" activities and reviews its chemical usage annually. For CY 2001, it was verified that no lead was "otherwise used" in a quantity exceeding 100 pounds and no other listed toxic chemicals were "otherwise used" in quantities exceeding 10,000 pounds in 2001; therefore, no TRI reporting was required.

Emergency Response Standards

Two environmental emergency response-related hazards exist at Jefferson Lab. One hazard involves releases resulting from the storage or transport of EHMs. Emergency response standards that apply to EHMs are CERCLA, the portions of 40 CFR noted above, and the Virginia Emergency Operations Plan. The second hazard is a radiological release, as addressed in 10 CFR 835.

There were four minor oil spills in 2001 that were mitigated promptly, none of which impacted the environment. There were no releases subject to CERCLA or other emergency response regulations in 2001.

3.9.5.2 P2 and Other Activities to Support Compliance

ISM

Jefferson Lab integrates safety (EH&S collectively) principles and functions into all work processes through the application of ISM. The ISM System objective is to make safety, health, and environmental protection a part of routine business at Jefferson Lab. Jefferson Lab intends to broaden integrated safety management during 2002 by incorporating EMS core elements and principles, as identified under EO 13148. Refer to Section 4.1 for more information.

General P2 Activities

Jefferson Lab complies with EO 13148 and the PPA P2 goals by minimizing use (source reduction), reusing to the maximum extent, recycling to the

extent possible, and, as a last resort, disposing of any wastes in the most environmentally safe manner. The Lab continues to establish P2 goals regarding reductions in standard sanitary waste, hazardous waste, and LLW generation, and for improving our recycling performance. A contractual Performance Measure addresses this and is noted in Section 3.10.2. Specific Lab P2 and E2 initiatives are discussed in Sections 4.2 and 4.5.5. There were no P2 compliance concerns in 2001.

3.9.5.3 Results of Environmental Compliance Reviews

There were no internal environmental compliance reviews, including that of ISM, in 2001. The results of inspections from regulators are provided in Section 4.3. Minor compliance-based issues were promptly addressed at the time of inspections and resulted in no findings of concern by regulators.

3.9.5.4 Progress on Implementing Environmentally and Economically Beneficial Landscaping Practices

Jefferson Lab uses qualified subcontractors to take care of the facility grounds. One beneficial practice is that grass cover is maintained in open areas to prevent runoff. Fertilizers and herbicides are applied locally only as needed and not when rain is imminent to prevent surface water contamination.

A new subcontract in FY 2002 will limit the watering of beds to weekly and encourage the use of environmentally preferable products such as compost, mulch, and items with recycled content.

3.9.5.5 EMS Self-Assessment Questionnaire

A self-assessment of Jefferson Lab's EMS status was provided to the DOE on September 21, 2001. Jefferson Lab does not have a separate EMS but implements the EMS principles through the Lab's ISM System Plan. Some of the items that make up an EMS, such as significant environmental requirements, goals, and timeframes are spelled out within the DOE/SURA operating contract and the Jefferson Lab EH&S Manual.

The Lab's ISM System Plan will be enhanced to incorporate EMS principles and core elements. Other site documents will be reviewed and improved to better incorporate EMS principles and practices.

3.9.5.6 Secretarial P2 and E2 Goals

Jefferson Lab is committed to meet ten targets that address seven out of the sixteen DOE-identified P2 and E2 goals. Additional funding will be needed to meet some targets. The Lab's status is depicted in Exhibit 3-3.

3.10 OTHER OBLIGATIONS IDENTIFIED IN THE CONTRACT

Jefferson Lab has other environmental protection and public health-related obligations. These obligations are incorporated into site programs, including subcontractual agreements, exclusive of direct legal requirements, e.g., Jefferson Lab's participation in DOE's NEPA process and implementing EO 13123.

3.10.1 NEPA

NEPA requires that projects with potentially significant environmental impacts be evaluated and alternative actions explored. These evaluations are to be performed and reported as EAs or Environmental Impact Statements. Jefferson Lab assists the DOE in implementing the NEPA process on the site, including preparing NEPA documents.

Exhibit 3-3
Targets and Progress Projections

DOE Goal	Action	DOE Goal FY 05 / FY 10	Lab 2005 Target	End FY 2001 Lab Status
1,2,3	*Waste Reduction (% of 1993 baseline)*			
1	Routine Hazardous Waste Generated	90%	46% to 5.0 MT	Met (4.0 MT)
1	LLW Generated	80%	63% to 3.5 M^3	Not Met (42 M^3)
1	Low Level Mixed Radioactive Generated	80%	0	Met (None to date)
2	TRI Chemical Releases	90%	Remain under reporting threshold	Met for CY 2001
3	Sanitary Waste from Routine Operations Generated	75%/ 80%	Not to exceed 1995 baseline (274 MT)	Not Met (283 MT)
4	Routine and Non-routine Sanitary Wastes Recycled (%recycled vs. disposed)	45%/ 50%	20% of by FY05 25% by FY10	Met (28% includes all recycled solids and liquids)
5	Reduce wastes from cleanup	10% annually	N/A	N/A
6	Increase purchases of EPA designated items w/recycled content	100%	95%	Not Met, but Progress (87% from 59% in FY00)
7	Reduce energy consumption in buildings and laboratories	40%/45% bldgs. 20%/30% labs	15% by FY05 using a 1992 baseline	Not Met (No values available for FY01)
8	Purchase 'clean' electricity	Increase purchases	None	-
9	Retrofit chillers made before 1984 using class I refrigerants	Complete by FY 05	N/A	N/A
10	Eliminate use of Class I ODSs to extent practicable	Complete by FY 10	Chiller replacement by FY05, others under review.	Not Met
11	Reduce greenhouse gas emissions	25%/30%	None	-
12	Reduce vehicle fleet annual petroleum use	20% (vs. FY99)	None	-
13	Acquire 75% of light duty vehicles as alternative fuel vehicles	Annually	Evaluate options with GSA	-
14	Increase usage rate of alternate fuel vehicles	80%/90%	None	-

NOTES: * if separate goals exist
MT: metric tons
M^3: cubic meters

An EA for the proposed Newport News site for CEBAF (now Jefferson Lab) was completed in 1987, prior to the construction of the facility, and resulted in a FONSI. In 1997, an operations-related EA for the CEBAF and FEL was completed, also resulting in a FONSI. A new EA covering the construction of five new structures to support lab operations was started in FY 2001. Refer to Section 4.4 for more information.

Jefferson Lab will respond to any requirements identified by the DOE with respect to NEPA compliance issues, of which there were none in 2001.

3.10.2 Performance Measures

Performance Measures are incorporated into the DOE/SURA Contract. Four of them reflect environmental protection issues. Exhibit 3-4 highlights relevant FY 2001 scores.

Exhibit 3-4
Contract Performance Measure Results

I. D.	Performance Measure Description	FY 2001 Score Received by the Lab
5.0b	Minimizing Environmental Exceedances	100%
5.3	Fraction of Solid Waste Recycled	100%
5.4a	Fraction of Radioactive Waste Produced for Useful Purposes	100%
5.4b	Ratio of Hazardous Waste Generated compared with the quantity that could have been generated if Waste Minimization was not practiced	100%

The calculations used for scoring are in the contract. (100% being optimal)

3.10.3 DOE Guidance

The current performance-based DOE/SURA Contract identifies DOE environmental protection and public health requirements in either a Performance Measure or in the Environment, Safety, and Health (ES&H) Responsibilities portion in Appendix E of the Contract.

Since incorporation of the WSS Set into the Contract, the only DOE environmental documents specifically identified in either the WSS Set or the Contract are DOE Orders 435.1, 5400.1, and 5400.5; DOE Notice 441.1; and, DOE Standard 1023-95. There are other orders in the Contract that do not apply to EH&S. A process for reviewing new or revised DOE Orders for applicability at Jefferson Lab was implemented in 1999 and 2000. In 2001, Jefferson Lab complied with applicable DOE documents, guidance, and related contractual commitments.

3.10.4 AL&R LIST

Administrative environmental protection and public health requirements are on the AL&R List. A violation would not directly impact the environment; however, it could result in an administrative action. AL&R standards are generally incorporated into site programs. There were no known non-compliance issues in 2001.

3.11 OTHER MAJOR ENVIRONMENTAL ISSUES AND ACTIONS

There were no major issues or actions identified in 2001 that could negatively affect the environment or public health. Here are a few noteworthy actions.

- The first shipment of LLW took place. RadCon implemented a new program to meet the DOE's new regulatory requirements.
- To help meet the Lab's waste minimization goal, a collaborative effort among Lab staff resulted in establishing local recycling centers at some key buildings for office related recyclables. For more information refer to Section 4.5.3.
- A new web page on the Lab's AP Program and an *EarthWatcher* Newsletter were introduced to the Lab community in early 2002.
- An effort by the Procurement Department to improve the Lab's performance in implementing AP. Refer to Sections 3.9.3 and 4.2.1 for more information.

3.12 RELEASE REPORTING

There are no releases that require continuous release reporting. There were a few small oil spills that are noted in Section 4.5.1. There were no reportable spills or releases of any materials in 2001.

3.13 PERMIT SUMMARY

Information about permits held in 2001 is presented in Exhibit 3-5.

Exhibit 3-5
Jefferson Lab Permits

SER Section	Permit Number	Description	Permit Dates
3.6.1.2	VA0089320	VPDES Permit - Specifies allowable groundwater and surface water quality on-site during accelerator operations. Assures groundwater unaffected at and beyond site boundary.	7/16/1996 through 7/16/2006
3.6.1.2	VAG253002	VPDES Permit - General Permit for Cooling Water Discharges - Authorizes cooling water discharges within identified discharge limitations.	9/1/1999 through 3/1/2003
3.6.2.1	HRSD No. 0117	Industrial Wastewater Discharge Permit - Limits wastes to be discharged to sewerage.	10/1/1987 through 3/1/2007
3.6.2.2	GW0030800	Permit to Withdraw Groundwater - Authorizes maximum quantities of water to be withdrawn by dewatering of area under experimental halls	11/1/1994 through 10/30/2004
3.3.2	4727-45-01	South Carolina Radioactive Waste Transport Permit - authorization to transport LLW within the state	9/14/2001 through 12/31/2001

SECTION 4 ENVIRONMENTAL PROTECTION PROGRAM

Jefferson Lab's mission includes protection of the environment and public health. There are many facets to the site EP program, which is integrated into facility operations under Jefferson Lab's ISM System Plan that also documents the site's EMS strategy. The site's EP program provides staff the requirements and guidance for making environmentally preferable choices, identifies requirements for radiological and non-radiological monitoring, and reviews performance through actions such as assessments and inspections. This section provides information on these and other EP and public health-related 2001 events and activities.

4.1 ENVIRONMENTAL MANAGEMENT SYSTEM

Jefferson Lab does not have a specific EMS, but acknowledges that the program's elements are accomplished through implementation of the Lab's ISM System Plan, which addresses environment, health, and safety principles and functions. The primary objective of the ISM System Plan is to make safety, health, and environmental protection a part of routine business at Jefferson Lab. Some items that make up an EMS, such as significant environmental goals and timeframes, are included in the DOE/SURA operating contract or in the Jefferson Lab EH&S Manual. In 2001, as per EO 13148, the Lab made a commitment to review and improve the ISM System Plan as well as the Lab's Quality Assurance Program Manual to specifically incorporate EMS principles and core elements in FY 2002. EMS is applied on site as described here.

Site EP Policy: Jefferson Lab has both a mission statement and an EH&S policy. The mission statement calls for excellence in all activities while the policy commits the Lab to preserving the natural environment as well as to conducting operations without adverse impact on the surrounding community.

Environmental Planning and Analysis Procedures: Environmental planning and analysis is handled by documenting and reviewing projects and activities for NEPA considerations. Line management is responsible for providing notice of actions and impacts to enable proper time for review and authorization as applicable. As well, some subcontracts are updated to require and encourage subcontractors to take EP into account.

Environmental Objectives and Targets: The Lab operates within contractual operating limits that include staying within permit criteria. Exhibit 3-3 lists the targets for many of the items identified in the Secretary's P2 and E2 Goals and Exhibit 3-4 shows four EP-related performance measures.

Implementation and Operations Controls: The DOE/SURA contract defines general terms and conditions for operation and performance. EMS/ISM roles and responsibilities, along with some implementation procedures, are included in the Lab's EH&S Manual. No separate EMS training has been provided.

Identification of Environmental Aspects and Impacts: No specific analysis has been performed; however, the primary environmental aspects at Jefferson Lab are radiological implications to air, water, the public, and to local biota.

Performance Measurement: The Lab semi-annually reviews performance measure results for various topical areas that include EH&S.

Corrective Action and Self-Assessment Procedures: The ISM System Plan is reviewed periodically and updated as necessary to keep it current, with information shared with the DOE Site Office. It was most recently updated in 2001. Implementation of the ISM System will be evaluated in 2002..

Management Review Process: The Lab's Director's Council, composed of top management, reviews the ISM System Plan periodically through the self-assessment noted above. The review is documented and open items are tracked until closure.

4.2 ENVIRONMENTALLY PREFERABLE PURCHASING AND BEYOND

Today's rapidly changing technologies, products, and practices carry the risk of generating materials and wastes that, if improperly managed, can threaten public health and the environment. In this regard, Jefferson Lab encourages, and in some cases requires, the purchase and use of products and services that have minimal impact on the environment, a noteworthy P2 practice. Providing proper disposition of wastes is mandatory. A few highlights about these site programs are noted below.

4.2.1 Environmentally Preferable Purchasing (EPP)

The Lab has committed to integrating environmental considerations into every aspect of the acquisition of products and services. This commitment is based on EPA requirements and the implementing goals that DOE has established to meet the applicable requirements. In managing this program, Jefferson Lab has accomplished the following:

- Assigned an EPP focal point to train staff as well as to track and report the amounts of EPA-identified recycled content products purchased in comparison to those not having recycled content;
- Set goals for: improving the performance of procuring EPA-identified items and minimizing (and eventually eliminating) all purchases of ozone-depleting substances; and,
- Kept staff informed about other factors, as possible, such as selecting non-toxic or bio-based as well as the most energy efficient items and materials rather than a product that could have a greater environmental impact.

During 2001, the Business Services Department and EH&S Reporting staff continued to encourage the purchase of EPA-listed materials having recycled-material content. Jefferson Lab's main office product supplier continued to highlight recycled-content-containing products in both its paper and on-line catalogs. There was significant improvement over last year's performance at buying recycled-content materials as reported in Section 3.9.3 and more opportunities to improve this level are being investigated. Also, EH&S Manual chapters dealing with the procurement of goods and services were expanded to incorporate EPP principles in 2001, a noteworthy action. For standard white

copy paper uses, where paper and services are provided by the central Copy Center, 30% recycled-content paper was utilized 100% of the time.

4.2.2 Environmentally Preferable Use and Disposal

Staff and users of Jefferson Lab are responsible for following environmentally sound use and disposal practices and procedures which are presented in Chapters 6610 and 6760 of the EH&S Manual. Two questions that staff and users are encouraged to ask themselves prior to making *any* and *all* purchases are: "Is this product safest for the environment and will it allow me to continue to do my job effectively?" and "Is this product composed of recycled post-consumer material?"

Use

Once the environmentally preferable product or service has been obtained or is being accomplished, Jefferson Lab staff continue to take EP, as well as health and safety, considerations into account. Factors such as ensuring secondary containment is present and that proper ventilation for the process is provided help to minimize exposure to potential hazards.

Disposal

Jefferson Lab staff have a range of options for disposition of materials to include recycling, neutralizing, scrapping, providing spent chemicals or equipment to co-workers on-site or to other DOE facilities, and disposing in a local landfill. The Lab intends for all items to be disposed of in the most environmentally acceptable manner that meets all applicable regulatory and contractual requirements. In accordance with these intentions, the Lab expanded its recycling efforts in 2001 by establishing "local recycling centers". Refer to Section 4.5.3 for more information.

4.2.3 Overview of the Environmental Monitoring Program

Environmental monitoring is one of the primary methods used by the Lab to assess environmental conditions. Monitoring is conducted to: verify compliance with applicable regulations and other requirements; evaluate the Lab's impact on the environment or public health; identify potential environmental problems; provide data to support management decisions; and, evaluate the need for remedial actions or mitigative measures.

The Environmental Monitoring Program establishes guidelines for examining chemical, oil, and radioactive effluents generated from the facility. An integral part of the program is routine sampling and tracking of air, process water, wastewater, and groundwater. These are monitored to ensure that Jefferson Lab effluents do not have a negative impact on the surrounding environment and that effluents remain within the allowable range. Jefferson Lab also assesses the effects of Lab activities by measuring, monitoring, and calculating the effects of past, current, and future Lab operations on the environment and public health.

Both permit-required and routine monitoring emphasize potential environmental exposure pathways appropriate to medium-energy particle physics laboratories. These pathways include external and internal exposure to radiation, the major focus of the site's program. The external exposure potential is from direct penetrating (10 CFR 834 (draft) and 10 CFR 835) and airborne radiation (40 CFR 61, Subpart H). The internal exposure pathway is from H-3 (tritium) and Na-22 (a sodium isotope) in potential drinking water sources. These exposure potentials are discussed in Section 5 and do not present a concern either on or off the Jefferson Lab site at this time.

Sampling is conducted in a manner that adequately characterizes effluent streams. Standard collection and analysis methods are used where applicable and are documented in program and departmental procedures. Routine environmental monitoring is performed under the direction of responsible line management and overseen by the Lab's Office of Technical Performance.

Environmental monitoring data collected in 2001 included:

- operational measurements at site boundary monitor locations;
- groundwater quality for long-term facility operations;
- effluents to the sanitary sewer;
- groundwater dewatering discharges; and,
- other effluent streams, such as the cooling water at the cooling towers.

On-site environmental surveillance continued in 2001. The environmental baseline data were obtained prior to the start of routine accelerator operations. Baseline data are compared with data obtained during ongoing facility operations to ensure that Lab operations are not adversely affecting public health or the environment.

Throughout 2001, the RadCon Group reviewed radiological and non-radiological environmental monitoring information stemming from accelerator operations for conformity with applicable standards. Refer to Section 5 for the environmental radiological program discussion and to Section 6 for environmental non-radiological program information.

4.2.4 Site Permits

Environmental permits held by the DOE Site Office are listed in Exhibit 3-5, and compliance with each is discussed in Section 3.6 of this report. All permits citing limits and conditions involving water are discussed in Sections 5.3 and 6.1.

4.3 APPRAISALS, ASSESSMENTS, AND INSPECTIONS

The DOE Site Office, the ORO Office, and various Commonwealth and local authorities provide external oversight of the Jefferson Lab EP Program. Actions of note in 2001 are described here.

External Appraisals

There were no environmentally related external appraisals performed in 2001. All previously identified deficiencies from prior external appraisals had been addressed and closed by the end of CY 2000.

DOE Review of Jefferson Lab Self-Assessment

The DOE Site Office's Overlay Report, produced in conjunction with SURA's annual Laboratory-wide self-assessment, covers EH&S topics, contains Site Office observations and reviews, DOE appraisal results, and other information. The Report provides an overall performance assessment for the year. For FY 2001, the Overlay Performance Evaluation Report yielded a rating of "Outstanding" in the EH&S category.

ISM (and EMS)

The ISM System Plan was reviewed and updated in 2001 and the ISM System program is to be assessed in 2002. Refer to Section 3.9.5.2 and 4.1 for more information.

External Reviews

An Emergency Management (EM) Peer Review was conducted in July 2001 at Jefferson Lab, which is categorized as a low-hazard, non-nuclear accelerator facility. The review covered many topics including how Jefferson Lab responds to various emergencies and situations such as hurricanes, oil spills, and power failures. The Peer Review Committee recognized the application of continuous improvement in this program as evidenced by the new staff-initiated changes to ensure that the identified goals were being accomplished. The Committee offered several suggestions for further refinement including that additional tabletop exercises should be scheduled. The EM program earned an "Outstanding" rating.

External Inspections

There were two external environmental inspections during 2001.

- The HRSD staff performed the annual Jefferson Lab site inspection on February 28. For this inspection, the HRSD chose not to visit any particular buildings, but reviewed Jefferson Lab permit records and HRSD meter information. Minor deficiencies were noted during the inspection, including a few missing meter inspection sheets, which were promptly mitigated. The inspector returned at a later date to

inspect all new meters and their service areas and found all to be in order.

- A DEQ inspection of the Lab's VPDES Groundwater Monitoring Permit (No. 0089320) occurred on March 27. The inspection encompassed a site visit to the permitted wells within the accelerator site as well as a records review. The inspector indicated a slight concern about the solids in the storm channel that includes Discharge #001 effluent, but had no recommendations to offer. No corrective actions were identified.

Line Self-Assessments

Line managers perform annual line self-assessments (LSAs) of their organizational elements. The LSAs are broad in scope, covering the accomplishment of the elements' goals, including EH&S. The Self-Assessment/Quality Assurance (SA/QA) Group performs independent assessments (IAs) of four of the Lab's organizational units each year, focusing on EH&S. Deficiencies identified through the IAs are tracked by SA/QA until the corrective actions are completed. One noted deficiency identified in 2001 involved the Lab's AP program. To ensure AP program requirements are properly applied in the acquisition and procurement processes the Lab's EH&S Manual is being amended to include necessary AP program information.

4.4 NEPA ACTIVITY

NEPA, as amended, outlines the Federal policy to restore and enhance the environment and to attain the widest range of beneficial use without degradation. NEPA-related actions are handled in conjunction with the DOE, which is committed to following the related EPA regulations. Jefferson Lab assists the DOE by preparing documents and performing assessments of existing documentation. NEPA actions performed in 2001 are as follows.

- Twelve CX's that pertain to regular activities, including the "Management of Radioactive Waste at TJNAF", were renewed.
- One new project CX that covers the demolition and construction of an area inside the FEL for future use as an injector test cave was approved.
- The internal approval process for very small-scale construction projects that are covered under existing CXs continued.
- The preparation of an EA to address proposed construction projects began. The EA identifies an addition for the FEL Building, additions for CEBAF Center, and new Technical Support, End Station Refrigeration, and Storage buildings.

4.5 SUMMARY OF OTHER SIGNIFICANT SITE ENVIRONMENTAL ACTIVITIES

4.5.1 Issues and Actions

Emergency Management Exercise: A 'suspect mail' incident at the adjacent ARC served as the 2001 emergency management exercise. The Lab, who serves as the building manager for the City, and area emergency response organizations responded to the 911 call. The 'suspect mail', which met the Federal Bureau of Investigation's alert criteria, turned out to simply contain paper scraps along with the intended paper document. Issues, such as interfaces with various response agencies and between Lab departments, were identified and line management has been working to resolve these issues.

EHM Spills: There were four minor oil releases involving a valve leak, the mishandling of an oil-based product by a staff member, a diesel fuel overflow from a manlift, and pump oil spillage at a spill tray. All instances were minor and quickly corrected by line management and EH&S staff.

SPCC Plan: This plan, which was reviewed and updated in 2001, encompasses handling, storage, and transportation of various oil and petroleum product lubricants, hydraulics, and cooling materials. For more information refer to Section 3.6.2.3 of this report.

Other items of note include:

- The HRSD awarded Jefferson Lab a Gold Pretreatment Excellence Award for its excellent performance record.
- The Lab continued to procure low-mercury fluorescent lamps and started handling the crushed lamps as universal waste, eliminating that hazardous waste stream.
- Jefferson Lab made its first shipment of radioactive waste as noted in Section 3.3.2.
- Environmental reviews:
  - A study was performed to identify the extent of potential jurisdictional wetlands at Jefferson Lab as well as to determine whether threatened and endangered species could be present on the site. Only one small (previously known) isolated wetland was identified through the study. Also, no resident federal or state threatened or endangered species, or flora and fauna species considered of special concern in Virginia were identified on or immediately adjacent to the Jefferson Lab site.
  - An analysis of groundwater flow direction and velocity was conducted late in 2001. Flow directions and seasonal variations in groundwater flow were consistent with those noted in a previous analysis. The groundwater flow velocities had a wide range across the site. Refer to Section 7 for more information.
- In accordance with EO 13148 requirements to achieve ODS reductions, information regarding ODS purchase restrictions was provided to Division EH&S Officers for implementation in their respective areas.

4.5.2 Waste Minimization and Pollution Prevention (WMin/P2)

The PPA established P2 as a national objective and the most important component of the environmental management hierarchy. Waste Minimization, in combination with other P2 strategies, is recognized as the most cost-effective form of environmental protection.

The purpose of Jefferson Lab's WMin/P2 Awareness Plan is to foster the philosophy that prevention is superior to either paying for special disposal or for remediation, and thus focuses on minimizing waste generation.

WMin/P2 reduces the quantity of EHMs and other pollutants or contaminants entering a waste stream or the environment prior to recycling or treatment. Various wastes, including air emissions and water discharges, can be significantly reduced or sometimes eliminated entirely by reviewing processes during the planning phase or prior to altering current operations. These practices benefit the environment, protect employees and public health, and reduce site waste disposal costs. Specific objectives of this program include:

- making employees aware of WMin/P2 program requirements, goals, accomplishments, and general environmental activities and hazards at the site;
- informing employees, users, and visitors of specific environmental issues such as opportunities for recycling; and,
- encouraging staff and recognizing efforts to enhance the environment through WMin/P2.

Plant Engineering and other staff continue to explore opportunities to find users or vendors that will take or buy items that are no longer needed for Jefferson Lab business. One disposition method, recycling, was expanded in 2001.

4.5.3 Recycling

The Lab continues to implement waste reduction strategies and to educate and encourage staff on the proper disposition of recyclable materials. Additional items were added to the recycling program in 2001.

Communication channels, such as the Lab newsletter and EH&S wall-mounted and electronic bulletins, continued to inform people about recycling activities. Through a collaborative effort between EH&S Reporting and Plant Engineering, office product recycling centers were established in two high-use buildings. These centers have containers for twelve recyclable product types that include fax/printer/inkjet cartridges, used batteries, transparencies, fiber mesh envelopes, and among other items, paper, aluminum, and plastic bottles. One item of note in November was that the first shipment of used toner cartridges was sent for remanufacturing. The small amount of monies received from the cartridges and from aluminum can proceeds are returned to the recycling budget to help pay for subsequent recycling activities. Lab-wide response and participation in recycling continues to grow.

The quantities of materials recycled in FY 2001 were reported to the DOE - the information is shown in Exhibit 4-1.

Recycling Centers Located at CEBAF Center (Building 12) and VARC (Building 28)

Exhibit 4-1
Quantities of Items Recycled or Reused in FY 2001

Description	Quantity (tons (kg), unless noted)
Paper Products (office paper & cardboard)#	35.0 (31,750)
Aluminum Cans#	0.56 (508)
Scrap Metal (reclaimed through GSA)	45.6 (41,400)
Used Oil	3.6 (3,300)
Used Coolant	1.8 (1,630)
Lead-acid Batteries	0.25 (230)
Fluorescent Lamps	0.86 (780)
Toner Cartridges#	320 pounds (145)
Transparencies#	22 pounds (10)
Computer Disks#	0.5 pounds (0.23)
Circuit Boards and Electronics	135 pounds (61)
New/Used All Occasion Cards*	143 pounds (65)

*DOE initiative - provide to St. Jude's Ranch for Children to reuse.
#Items collected in office, kitchen, and recycling centers. (No small batteries were provided for recycling in 2001.)

4.5.4 Hazardous and Special Wastestreams

Variations in hazardous waste generation rates have been recognized and documented with the use of Performance Measures. Jefferson Lab has made notable progress in meeting hazardous waste minimization objectives. Accelerator Division EH&S staff, in particular, continued to emphasize substitution, reduction, and reuse of hazardous materials in the workplace.

In the category of special wastestreams, Jefferson Lab generated about 4.7 tons (4,300 kg) of hazardous waste, about 13 tons (42 cubic meters) of LLW in the Lab's first LLW shipment, and no TSCA or mixed wastes (a combination of hazardous and radioactive) during FY 2001.

This large amount of LLW was primarily due to designating as waste some radioactive materials that were being stored in special holding areas to allow for decay and possible reuse. This material was designated waste and prepared for shipment. RadCon completed the loading and surveying of the special shipping containers and turned them over to the waste broker for disposition in July. The broker took physical possession of the waste in early August and transported the material from the site.

4.5.5 Other Measures to Minimize Environmental Consequences

Energy Efficiency

- In 2001, Jefferson Lab received a DOE grant to develop an energy efficient klystron to replace present units (at 340 locations) as they are retired. The estimated annual power savings is 10 Gigawatt Hrs. (Note that klystrons require large amounts of power.)
- One of the initiatives proposed by Plant Engineering also involves the accelerator's klystrons. Plant Engineering requested DOE funding to install a combination of multitap autotransformers and modulating anode control software to decrease power consumption. The proposal is estimated to annually save 8.1 Gigawatt Hrs.
- All buildings were reclassified based on usage according to a DOE guidance memorandum. Plant Engineering continues to monitor energy activities for many site buildings. This work includes the preparation of studies, analyses, and the review of building and system designs, and the monitoring of resource consumption.

Environmental Quality Enhancements

- The Test Lab's use of solvents was virtually eliminated, and the acid usage in the cavity production process is being maintained at 50% below previous use. These improvements are due to the combined efforts of the lab users, the process designers, and the Accelerator Division EH&S staff.
- Oil-spill prevention controls were added and/or improved in a number of work areas, including in the SNS work area in the Test Lab.
- Recycling centers were added at the VARC and at CEBAF Center, an effort that has considerably increased staff awareness. More centers will be added during 2002.

SECTION 5 ENVIRONMENTAL RADIOLOGICAL PROGRAM

Radioactive materials are used in many research activities at Jefferson Lab. The radiological impact of these materials and potential effective dose equivalents to members of the public from various pathways such as inhalation, ingestion, and skin absorption were evaluated to show compliance with EPA and DOE regulatory limits. During 2001, very low levels of radioactive gaseous and particulate emissions were released from facility ventilation exhausts.

Radioactivity: A natural and spontaneous process by which the unstable atoms of an element emit or radiate excess energy from their nuclei and, thus, change (or decay) to atoms of a different element or to a lower energy state of the same element.

Jefferson Lab operations had minimal radiological dose impact to the public and the environment. The ambient external dose measured was on the order of 2% of natural background levels or 7 mrem (70 μSv (microSieverts)). The effective dose equivalent to the maximally exposed individual from air emissions for 2001 was calculated to be 0.011 mrem (0.11 μSv), as reported to the EPA. This dose is insignificant when compared to the EPA regulatory public air-dose limit of 10 mrem/yr (100 μSv/yr). The annual effective dose equivalent to an individual consuming contaminated water was so small it could not be measured. The maximum dose impact to the individual from both the air and direct pathways combined was 7 mrem (70 μSv). This is 7% of the DOE regulatory dose limit for members of the public from all pathways, which is 100 mrem (1000 μSv).

In 2001, the dose to terrestrial biota was also evaluated. No radiological doses either to terrestrial animals or plants above natural background were recorded from Jefferson Lab operations. There are no aquatic species in the Jefferson Lab vicinity that could be affected by Jefferson Lab operations, so no such dose estimates are provided.

A summary of dose and release reporting for 2001 is provided in Exhibits 5-1, 5-2, and 5-3. More detailed information is provided later in the chapter. Note that information about all electron accelerator-related radionuclides, with the potential for release from the site, is documented in this chapter. All important discharges or releases of radioactive constituents are documented herein. There were no non-routine releases in 2001 so all values shown result from routine operations.

Exhibit 5-1
Jefferson Lab Radiological Dose Reporting Table for CY 2001

Pathway	Dose to Maximally Exposed Individual mrem / (mSv)	% of DOE 100 mrem/yr Limit	Estimated Population Dose (person-rem) / (person-Sv)	Population within 80 km	Estimated Background Radiation Population Dose (person-rem)/(person-Sv)
Air	1.1 E-2 (1.1 E-4)	0.011 (2.5 E-4)	0.025	-	N/A
Water	0	0	N/A	-	N/A
Other Pathways	7 (7 E-2)	7	Unknown/ Unknowable	-	N/A
All Pathways	7 (7 E-2)	7		214,000 est.	N/A

Note: 0.011 = 1.1 x 10-2 = 1.1E-2

Values presented in Exhibits 5-1, 5-2, & 5-3 are presented in Scientific Notation (example, 2 E-05 is 0.00002)

Exhibit 5-2
Jefferson Lab Radiological Atmospheric Releases for 2001 [in Ci (Bq)]

Radionuclide [half-life]	Tritium [12.26 yr]	Be-7 [53 .6 days]	C-11 [20.3 m]	N-13 [9.96 m]	O-15 [123 sec]	Cl-38 [37.29 m]	Cl-39 [55.5 m]	Ar-41 [1.83 hr]
Ci (Bq) in CY 2001	2.15 E-02 (7.96 E8)	3.71 E-03 (1.37 E8)	1.05 E+00 (3.89 E10)	7.90 E+00 (2.92 E11)	4.19 E+00 (1.55 E11)	4.49 E-02 (1.66 E9)	5.48 E-01 (2.03 E10)	2.11 E-03 (7.81 E7)

Notes: 1 pCi = 1 x 10E-12 Ci = 0.037 Bq

m: minutes

All data involving activity from reactor facilities (^{85}Kr, Uranium, etc) is not applicable for Jefferson Lab.

Exhibit 5-3
Jefferson Lab Liquid Effluent Releases of Radioactive Material for 2001 [in Ci (Bq)]

Radionuclide	Tritium	Be-7	Na-22
Ci (Bq) in CY 2001	8.8 E-1 (3.3 E10)	2.8 E-05 (1.04 E6)	6.6 E-06 (2.44 E5)

Notes: Permit level is 5 Ci for Tritium and 1 Ci for all other gamma-emitting radionuclides.
All data involving activity from reactor facilities (fission and activation products) is not applicable for Jefferson Lab.

5.1 SITE INFORMATION

Jefferson Lab protects the environment and the public from exposure to radiation. The radiological monitoring program is the primary means used at Jefferson Lab to verify accomplishment of this objective. Other support activities include: using permanent and temporary shielding; using active and passive controls at activated water locations; and, following proper protocols when handling radioactive materials and wastes.

The radiological monitoring program is designed to verify that radiation exposures, both for on-site radiation workers and for members of the general public, are below permissible levels and as low as reasonably achievable. The program also assures that Lab support activities and accelerator testing and operations, as described within the approved operational safety envelope, will result in minimum impacts to the environment and have minimal to no effects on public health.

5.2 ENVIRONMENTAL RADIATION MONITORING

Accelerator operations produce three types of radioactivity that can impact the general public: direct or prompt, airborne, and waterborne. Jefferson Lab performed extensive environmental monitoring in 2001 to measure these three forms of accelerator-produced radiation. Pathways to the general public are modeled and monitored when appropriate or as indicated by law. The decision to monitor a particular pathway is based on the:

- type of operations;
- radionuclides released;
- potential hazard;
- experience from previous monitoring results at Jefferson Lab; and,
- experience at other nuclear and high-energy physics laboratories.

5.3 AIRBORNE AND WATERBORNE RADIOACTIVITY

Radiation resulting from the accelerator beam or the interaction of the beam with matter is called direct (or prompt) radiation. This direct radiation is produced within the beam enclosure and stops being generated as soon as the accelerator is turned off.

5.3.1 Direct Radiation and Airborne Radioactivity

In addition to direct radiation, the interaction of the accelerator beam with matter can cause the formation of radioactive materials through activation of the matter. The beamlines, magnets, beamline-components, targets, detectors, other experimental area equipment, and the energy dissipating devices (beam dumps) used to contain the beam's energy may become activated. Cooling and ground waters, lubricants, and air in the beam enclosure may also become activated. These activated air, water, and particulates are possible sources of airborne and waterborne radioactivity. Though the direct radiation stops when the accelerator is turned off, this activated equipment, water, and air continue to emit radiation.

Controls are in place to minimize the effects of both direct radiation and radiation from activated materials on Lab personnel, the environment, and the public.

- The beam enclosure area is surrounded by radiation shielding.
- Direct radiation is monitored both on-site and at the site boundary.
- Interlocked access points provide a fail-safe barrier against entry to the beam enclosure during accelerator operations.
- The monitoring of airborne radioactivity is carried out locally to validate calculations and estimates of radiation dose.
- All material exposed to the beam is monitored for radioactivity prior to being removed from the beam enclosure.

Shielding Blocks at the Hall C Truck Ramp Entrance

While radiation dose rates offsite are expected to be well below limits set for the general public, monitoring ensures that the established controls are effective.

- Waterborne activity is discussed in Section 5.3.2.
- Monitoring for exposure of the public to direct radiation is discussed in Section 5.4.
- The monitoring for public exposure to airborne emissions is addressed below.

Airborne Radioactivity: Radioactive material in any chemical or physical form that is present in ambient air, above natural background. This radioactivity can be generated by interaction with direct radiation.

Airborne emissions at the site boundary are addressed under EPA requirements discussed in Section 3.5.2. Airborne radionuclide concentrations at the site boundary have been too low to accurately measure. Annual calculations, using EPA-approved computer modeling codes, have indicated that Jefferson Lab operational emissions remain several orders of magnitude lower than the EPA 10 mrem/yr reporting limit. Calculated results based on an EPA-approved computer program, CAP-88 PC, are presented in Exhibit 5-4. Despite this very low calculated release rate, Jefferson Lab continued being proactive in 2001 by making continuous measurements to verify the calculations. A report covering CY 2001 was sent to the EPA as described in 40 CFR 61. This report documented that the dose to a maximally exposed individual of the public was 0.011 mrem/yr (0.11 μSv/yr) due to airborne releases. The dose from exposure through all applicable pathways is presented in Exhibit 5-1.

Lab programs and outside advisory committees ensure that the Lab continues to function within regulatory and established administrative limits for direct radiation and airborne emissions. One entity is the Experimental Equipment Review Committee that reviews experiments for EH&S parameters, as well as for experimental and facility usage criteria. Another is a RadCon review of projected public exposures and airborne emissions from proposed experiments to help the Lab remain within established guidelines. Refer to Section 5.4 for specific information on the monitoring of direct radiation.

Exhibit 5-4
Nuclide Effective Dose Equivalent Summary

Nuclide	H-3	Be-7	C-11	N-13	O-15	Ar-41	Cl-38, 39	TOTAL
Calculation for Selected Individual Based on Conservative Calculations and Measurements (mrem/yr.)	9.9 E-6	3.2 E-5	1.1 E-3	6.9 E-3	2.0 E-3	2.8 E-6	1.2 E-3	1.1 E-2

Conversion note: 1 mrem = 0.01 millisievert (mSv)

Values are presented in Scientific Notation (i.e., 1.2 E-3 = 0.0012)

5.3.2 Waterborne Radioactivity

Groundwater

Radioactivity in groundwater, as a result of direct or secondary radiation, is possible in certain locations around the shielded accelerator and experimental hall structures. The VPDES groundwater quality permit serves as the basis for evaluating accelerator-produced radioactivity in groundwater. Under the permit, Jefferson Lab is not allowed to exceed one-quarter of the EPA SDWA limits on-site, or change the quality of the groundwater offsite. Refer to Section 7 for more information on how the Lab incorporates monitoring to protect groundwater resources.

This VPDES groundwater quality permit specifies EPA-approved sampling and analysis protocols, which were the basis of groundwater monitoring in 2001. Fifteen wells were sampled at quarterly, semi-annual or annual intervals. The permitted wells included the "A", "B", and "C" Ring wells (labeled as to proximity to the accelerator) and the upgradient well. Refer to Exhibit 5-5 for monitoring well locations and to Exhibit 5-6 for parameters sampled. The groundwater dewatering effluent at the experimental halls was also monitored quarterly in 2001 and reported under this permit.

Water samples have been drawn and analyzed since 1987. The data collected, through the completion of facility construction in 1995, provide a groundwater quality baseline for comparisons during long-term facility operation. The background samples were analyzed for naturally occurring radionuclides, as well as accelerator-produced radionuclides, and selected chemical parameters. The radionuclides analyzed in 2001 are those known to relate to operations associated with electron accelerators. They include H-3 (Tritium), Be-7, Na-22, Mn-54, and gross beta. Total manmade radioactivity was also analyzed.

Exhibit 5-7 lists the VPDES groundwater quality permit levels for radiological parameters with values in picocuries per liter (pCi/l). The values in Exhibit 5-6 represent normal background radionuclides, which are also generated through Jefferson Lab activities.

The radiological results from monitoring the wells in the accelerator vicinity during 2001 are presented in the first part of Exhibit 5-8. The results from the other locations described in the permit are shown in the second half of the exhibit. All measurements were within permit levels. No accelerator-produced activity has been detected. All values represent natural background, and variations are normal.

Other Water Monitoring

The surface water sampling program commenced at the time construction of the experimental halls was completed. Quarterly sampling of the groundwater dewatering surface discharge under the VPDES groundwater quality permit continued. In addition, automated sampling equipment is used to analyze the discharged water for tritium and gross beta. There were no concerns at this discharge stream in 2001.

Exhibit 5-5
Monitoring Well Locations

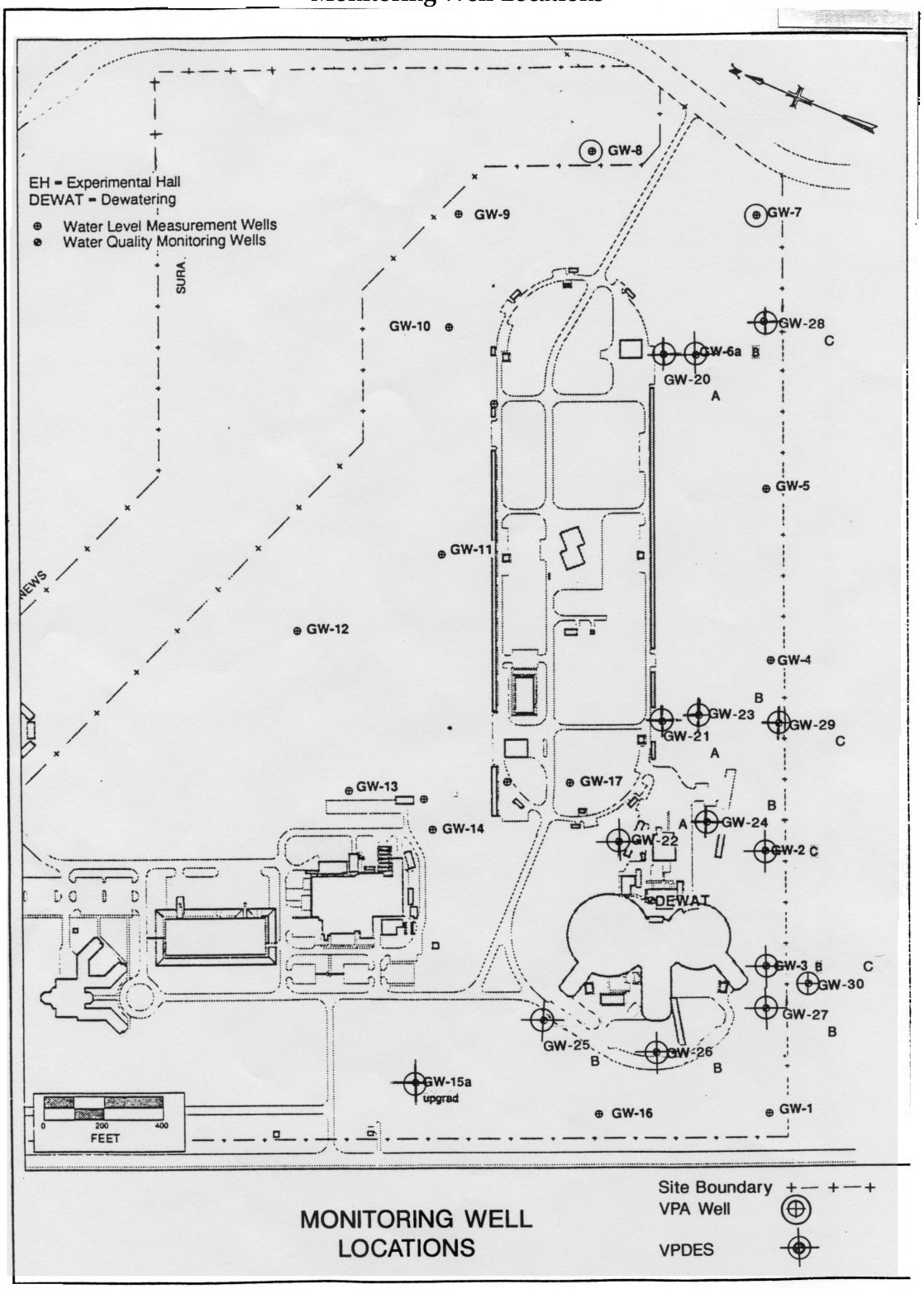


Exhibit 5-6
Groundwater Sampling Parameters

Wells	Sampling Frequency	Environmental Parameters
GW-15a	Annual	groundwater elevation, pH, conductivity, TSS, TDS, and radionuclides listed
A Ring Wells		
GW-20 GW-21 GW-22	Quarterly	groundwater elevation, pH, conductivity, TSS, TDS, manmade radioactivity, and radionuclides listed
B Ring Wells GW- 3 GW-6a GW-23 GW-24	Semi-annual	groundwater elevation, pH, conductivity, TSS, TDS, manmade radioactivity, and radionuclides listed
C Ring Wells GW- 2 GW-28 GW-29 GW-30	Annual	groundwater elevation, pH, conductivity, TSS, TDS, and radionuclides listed
Other Sampling Point		
Outfall 001	Quarterly	flow, pH, and radionuclides listed

Radionuclides: Gross Beta, H-3 (Tritium), Be-7, Mn-54 and Na-22
TDS: Total Dissolved Solids
TSS: Total Suspended Solids

Exhibit 5-7
VPDES Permit Levels for Radionuclides*

Analyte	A-Ring (Action Level)	B-Ring (Permit Level)	C-Ring (Permit Level)	Sensitivity & Precision (Permit Value)
Gross Beta	50 pCi/l	50 pCi/l	153 pCi/l	4 pCi/l
Manmade Radioactivity	1 mrem/yr.	1 mrem/yr.	-	-
Tritium	5000 pCi/l	5000 pCi/l	1000 pCi/l	1000 pCi/l
Sodium-22	-	-	61 pCi/l	40 pCi/l
Beryllium-7	-	-	835 pCi/l	600 pCi/l
Manganese-54	-	-	51 pCi/l	30 pCi/l

Notes: *Those radionuclides determined to be relevant to Jefferson Lab operations.
A-ring levels are action levels only.
Numbers are representative of pre-operational measurements plus 2 standard deviations, which represent a 99% certainty that deviations above this level are not random.
Conversion: 1 pCi = 0.037 Bq, 1 mrem = 0.01 mSv

Exhibit 5-8
Maximum Groundwater Measurements for Radionuclides*
January 2001 through December 2001

Radionuclides at Associated Wells Relevant to Accelerator Operations

Analyte	A-Ring	B-Ring	C-Ring
Gross Beta	30.33 pCi/l	35.67 pCi/l	4.06 pCi/l
Manmade Radioactivity	< 0.273 mrem/yr.	< 0.199 mrem/yr.	not applicable
Tritium	ND at < 704 pCi/l	ND at < 705 pCi/l	ND at < 704 pCi/l
Sodium-22	ND at < 21.9 pCi/l	ND at < 14.5 pCi/l	ND at < 7.89 pCi/l
Beryllium-7	ND at < 168 pCi/l	ND at < 107 pCi/l	ND at < 61.8 pCi/l
Manganese-54	ND at < 21.1 pCi/l	ND at < 15.8 pCi/l	ND at < 7.27 pCi/l

Radionuclides At Other Permit Locations

Analyte	Upgradient Well	Discharge 001
Gross Beta	2.35 pCi/l	18.81 pCi/l
Tritium	ND at < 704 pCi/l	ND at < 704 pCi/l
Sodium-22	ND at < 13.7 pCi/l	ND at < 25.7 pCi/l
Beryllium-7	ND at < 110 pCi/l	ND at < 168 pCi/l
Manganese-54	ND at < 16 pCi/l	ND at < 17.0 pCi/l

Notes: *Those radionuclides determined to be relevant to Jefferson Lab operations.
No accelerator-produced activity has been detected.
ND: Not detectable above permit-required sensitivity limits
Conversion: 1 pCi = 1 x 10^{-12} Ci = 0.037 Bq

The Cooling Water Tank (Building 92) and the floor drain sump (FDS) pit (Building 97) are considered one HRSD sampling point. Sampling at the FDS pit, which collects various discharges, including low-level activated dehumidification condensate from air conditioning systems located in the experimental halls, and at the Cooling Water Tank, that contains activated water from various accelerator apparatus, continued in 2001. Sampling and analysis for tritium are performed prior to any discharges to the sanitary system. The results are recorded and monthly and quarterly concentration values are provided to HRSD. Some regulatory values (that are not required to be regularly reported) are tracked and documented by the RadCon staff, such as the total amount of activity discharged to the sanitary sewer system. Monthly and composite quarterly results for 2001 are provided in Exhibit 5-9. The concentrations varied based on the quantity of beam dump cooling water discharged during the reporting period.

On a periodic basis in 2001, other water sampling and analysis for tritium and gross beta activity were performed on various discharges from potential radiological areas, such as from sump pumps. Any water identified as a potential concern was collected and discharged according to the terms of the HRSD permit.

Various accelerator-related water systems have the potential for becoming activated. Secondary containment and other physical controls are present around areas with the potential for spills of activated water. Additional administrative controls are in place where the water activation level is above an identified level.

There were a few minor water spills or leak events in 2001 involving these activated water systems. The RadCon staff addressed and cleaned up the areas involved. There were no worker safety, environmental, or public health concerns. Collected water that did not meet immediate disposal criteria was transferred

Exhibit 5-9
Analytical Results for Discharges to HRSD in 2001

Monthly Values

Reporting Period	Tritium Concentration	Reporting Period	Tritium Concentration
January	29,000 pCi/l	July	3,800 pCi/l
February	0 pCi/l	August	28,000 pCi/l
March	20,000 pCi/l	September	40,000 pCi/l
April	43,000 pCi/l	October	79,000 pCi/l
May	41,000 pCi/l	November	25,000 pCi/l
June	37,000 pCi/l	December	52,000 pCi/l

Quarterly Values

Reporting Period	Tritium Concentration	Other Gamma-Emitting Radionuclides Concentration
First Quarter	20,000 pCi/l	None detected
Second Quarter	42,000 pCi/l	None detected
Third Quarter	24,000 pCi/l	Na-22 at 0.24 pCi/l
Fourth Quarter	55,000 pCi/l	Na-22 at 0.82 pCi/l and Be-7 at 4.7 pCi/l

Notes:

These effluent concentrations are well below the 0.1 μCi/ml (100,000,000 pCi/l) permit limit.

Radionuclides are analyzed at EPA sensitivity levels or better.

Conversion: 1 pCi $= 1 \times 10^{-12}$ Ci = 0.037 Bq

to a temporary storage area for later release to HRSD.

5.4 ACCELERATOR-PRODUCED DIRECT RADIATION

Direct radiation penetrates shielding with almost all this radiation stopped by the shielding; any exposure to this radiation is at a maximum on-site and decreases with distance. During 2001, Jefferson Lab continued regular accelerator operations in support of various physics experiments in the three experimental halls. Accelerator operations and related activities produced significant amounts of direct radiation; however, these amounts were restricted within constraints as managed by RadCon and were performed within an approved safety envelope.

The Jefferson Lab areas, where direct radiation can be produced, are not accessible during accelerator operations. There are approximately 50 electronic radiation detectors and a series of associated passive integrating detectors deployed around the accelerator site with the primary purpose of measuring on-site radiation. The majority of the electronic detectors are connected to a central computer system that can automatically record the radiation levels for subsequent examination. When appropriate, Jefferson Lab employees, contractors, and visitors wear detection devices to monitor for on-site radiation exposure.

Six dual-channel microprocessor-based instruments for monitoring gamma and neutron radiation levels collected both direct and airborne radiation data at the site boundary in 2001. Radiation data collected prior to January 1995 serve as the statistical baseline for comparison to that collected since the accelerator became fully operational.

5.5 ASSESSMENTS OF POTENTIAL RADIATION DOSE TO THE PUBLIC AND TO BIOTA

The six electronic radiation measurement devices noted in Section 5.4, installed along the

accelerator site boundary continued to be used to determine offsite dose to the public due to Jefferson Lab operations. These electronic detectors - radiation boundary monitors (RBMs) - measure and log radiological information at the locations shown in Exhibit 5-10. In addition, passive integrating detectors were used for a number of measurements. All measured dose values were within statutory and administrative limits. For 2001, the highest site boundary direct (prompt) radiation level was about 7.1% of the DOE annual dose limit of 100 mrem (1 mSv), or 71% of the site administrative dose limit.

Exhibit 5-11 displays the radiation doses in mrem for 2001 at RBM-3. A comparison with natural background radiation is made, which indicates the relatively low levels of Jefferson Lab's contribution to the public dose. These background levels do not include contributions to dose from Radon, which typically doubles natural radiation dose to the public.

Jefferson Lab does not release any residual radioactive material, such as concrete or soil, so there are no resulting dose impacts to the public. Radioactive waste was turned over to a licensed subcontractor for reprocessing as appropriate to optimize the final disposition.

The absorbed dose to any local aquatic animals, or terrestrial plants or animals, from Jefferson Lab operations will not exceed the internationally recommended dose limits for terrestrial biota. As there are no potential releases of a magnitude that could result in doses exceeding 0.1 rad/day to terrestrial animals, the lowest limit for any biota, no dose limits will be exceeded.

Jefferson Lab did not contribute significantly to the radiation dose received by the public through either airborne and/or groundwater pathways. The direct radiation exposure was again measurable in 2001, but was found to be about 71% of the Jefferson Lab design goal of one-tenth of the DOE limit.

5.6 OTHER SUPPORT ACTIVITIES

Permanent shielding in the form of thick concrete walls and earth berms protect the environment from exposure. Additionally, labyrinth entrances and monitoring at ventilation ports track exposure values.

RadCon installs shielding blocks and devices as needed to minimize impacts both inside and outside the facility.

All areas where activated water could be present have controls in place. Locations with a high potential for activation have secondary containment measures installed and administrative lockout/tagout controls. Other areas with less or no potential for activation are monitored periodically to ensure levels are within expected values.

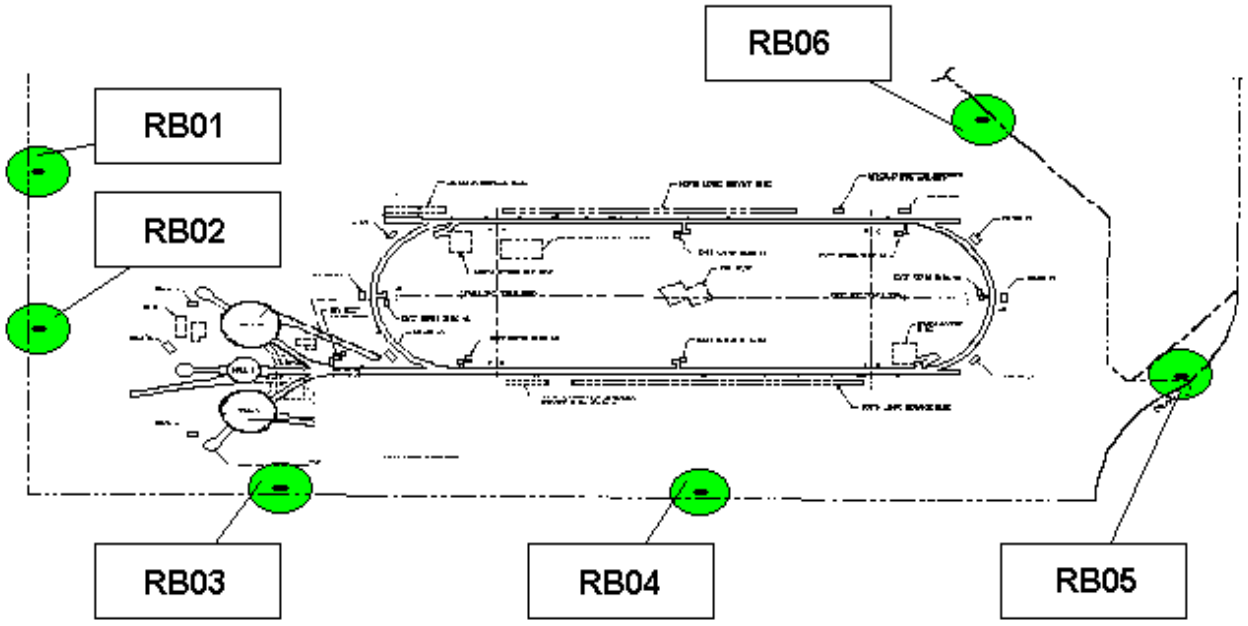
RadCon establishes access-controlled areas to temporarily store radioactive materials, including those being stored for decay, and wastes. There is no impact to the environment or public health from the small quantity of materials stored on-site.

SECTION 6 ENVIRONMENTAL NON-RADIOLOGICAL PROGRAM

There are a number of non-radiological activities that Jefferson Lab performs in supporting protection of the environment and public health performed under the site permits listed in Exhibit 3-5. This section presents the monitoring results for 2001.

Other activities include reviewing conventional air emissions; administering appropriate controls involving work with chemicals such as herbicides and cooling water treatment additives; reviews for emergency planning regarding on-site chemicals; and, special waste management. These programs are discussed in Section 4.

Exhibit 5-10
Boundary Monitor Locations



Note: RB03 is the same as RBM-3.

Exhibit 5-11
Radiation Boundary Monitor RBM-3 Results for 2001

Period	Neutron (mrem)	Gamma (mrem)	Total (mrem)
Jan-Mar	2.90 ± 0.35	0.73	3.63 ± 0.44
Apr-June	0.97 ± 0.30	0.24	1.21. ± 0.38
July-Sept	0.43 ± 0.30	0.11	0.54 ± 0.38
Oct-Dec	1.39 ± 0.26	0.35	1.74 ± 0.33
TOTAL	5.69 ± 0.60	1.43	7.12 ± 0.76
Natural Background	~1.8	~110	~112

Notes:
Statistical errors are quoted at 1 sigma.
Systematic errors including calibration (not included) are approximately 20% for neutrons.
Gamma dose equivalent rates are estimated based on best known statistical correlation techniques.
RBM-3 received the highest dose.
Conversion: 1 mrem = 0.01 mSv

In general, controls to protect the environment are established through on-site programs and subcontractual agreements that address permit condition requirements and other identified Lab commitments or initiatives. There were no problems with respect to any of the aforementioned Jefferson Lab activities during 2001.

6.1 WATER PROGRAMS

Jefferson Lab reported DEQ information under three permits in 2001: flow quantities under the Permit to Withdraw Groundwater; radiological and general water quality parameters under VPDES Permit No. VA0089320; and, general water quality factors under VPDES Permit No. VAG253002. Results were also reported under the HRSD Permit No. 0117. Radioanalytical results are provided in Section 5, and the rest of the results are included in this section.

6.1.1 Permit to Withdraw Groundwater

As noted in Section 3.6.2.2, Jefferson Lab's withdrawal of groundwater at the experimental halls is an unusual situation. The only factor of concern under the groundwater withdrawal permit is the quantity of water pumped. Quantities of water pumped from these tile fields are reported to the DEQ on a quarterly basis. This Permit allows the pumping of a maximum of 6,000,000 gallons per month. The other pumpage restriction is a yearly limit of 23,036,790 gallons. There were no unusual issues regarding this discharge in 2001.

The maintenance of the structural integrity of the halls by pumping results in wide quantity variations. Pumping is minimal in drought periods. Exhibit 6-1 presents the quantity of water pumped monthly and the maximum daily flows for each month in 2001. Note that the quantity pumped each month is well under the six million gallon permit limit.

This discharge point, known as "Outfall 001" in the VPDES Permit No. VA0089320, is monitored for water quality. Non-radiological results covered by this VPDES permit are presented in Section 6.1.2. Refer to Section 5.3.2 for information on the radiological parameters that are monitored due to proximity to the accelerator. Besides the VPDES permit noted, there are no other requirements for monitoring as no industrial or other use is made of the discharged groundwater.

6.1.2 VPDES Permit No. VA0089320

This permit covers monitoring for water quality at both groundwater monitoring wells and at the dewatering effluent collection point "Outfall 001".

Exhibit 6-1
Flow Information at the Dewatering Discharge

Month, 2001	Monthly Flow	Maximum GPD During the Month*	Month, 2001	Monthly Flow	Maximum GPD During the Month*
January	405,751	15,140	July	436,920	16,092
February	337,584	15,024	August	352,128	16,535
March	419,860	15,715	September	415,122	15,919
April	369,565	18,993	October	384,800	23,900
May	394,907	15,706	November	388,094	16,375
June	415,343	16,903	December	297,806	16,417

Notes:
*Maximum GPD per quarter is reported on VPDES Permit No. VA0089320.
There is no daily permit limit. The monthly limit is 6,000,000 gallons and the yearly limit is approximately 23,000,000 gallons.

Monitoring wells were sampled for pH, conductivity, total suspended solids (TSS), and total dissolved solids (TDS) under the Permit terms. (See Exhibit 5-5 for the site map showing the well locations monitored in 2001.) The sampling results for the wells are presented in Exhibit 6-2. Groundwater collected from the dewatering process at Outfall 001 is sampled and reported quarterly for pH and results are shown in Exhibit 6-3. The maximum daily discharge quantity for each quarter is also reported. Note that sampling data collected in 2001 was representative of groundwater quality during accelerator operations and is consistent with previous baseline measurements.

Variations in non-radiological information collected at the wells in 2001 may be due to seasonal, local ground conditions, and earth-disturbing factors. Even with a fully operating accelerator, various construction projects in the area, and a variety of physics experiments being performed, there were no facility-related effects on groundwater quality in 2001.

6.1.3 VPDES Permit No. VAG253002

Cooling water discharges from two cooling towers were covered by this permit in 2001. The materials used for cooling water treatment were Coastline Formula 2029 (scale and corrosion inhibitor), Formula 1909 (liquid biocide), and a small amount of a dispersant. There were no environmental concerns with the use of these chemicals.

Quarterly sampling and reporting are performed under this VPDES General Permit. Note that the discharge from a small tower at the Test Lab, Discharge Number 002, was added to the permit at the end of 2000. The revised permit requires that results for flow, pH, temperature, total hardness, total dissolved copper, total dissolved zinc, and total residual chlorine be provided to the DEQ. The 2001 results are provided in Exhibit 6-4.

Two notable situations occurred in 2001. The first, during the third quarter, involved Discharge 002. There was no available

Exhibit 6-2
Range of 2001 Non-Radiological Monitoring Results at Wells

Parameter/Units	GW-15a	A Wells	B Wells	C Wells	Permit Limit
pH	4.5	5.8 to 6.4	5.4 to 7.1	5.3 to 7.1	None
Conductivity (μmhos/cm)	182	719 to 2038	384 to 1149	467 to 963	None
TDS (mg/l)	82	474 to1450	223 to 750	331 to 627	None
TSS (mg/l)	4	23 to 34	4 to 26	3 to 45	None
(frequency)	(annual)	(quarterly)	(semiannual)	(annual)	-

mg/l: milligrams/liter

Exhibit 6-3
2001 Permit-Related Non-Radiological Monitoring Parameters at Outfall 001

Quarter	Maximum Flow (MGD)	pH
First	0.016	6.7
Second	0.019	7.1
Third	0.017	7.1
Fourth	0.024	7.4

MGD: million gallons/day
Note: There is no limit on the reported flow.
The pH range is 6.0 to 9.0.

flow to sample at the sampling point as there is only a very small flow from this tower, which was immediately absorbed into the soil, and the fact that there was very little rainfall. The second incident was that the chlorine level at Discharge Number 001, which has a more steady discharge from its tower, was above the non-detect level during the 4th quarter. Because there was no known explanation for the reading, the matter was investigated. A complicating factor was that there were large city water leaks in the area around that time. No plausible explanation for the elevated chlorine has been determined.

6.1.4 HRSD Permit No. 0117

Industrial wastewater, which includes a small quantity of activated water, is generated by Jefferson Lab and discharged to the HRSD through our Industrial Wastewater Discharge Permit. The activated water that was collected and discharged in 2001 was a combination of the output from dehumidification equipment in the experimental halls and small withdrawals from the beam dump cooling systems. Refer to Sections 3.6.2 and 5.3.2 for more information.

Jefferson Lab and the HRSD perform pH sampling of discharges as shown in Exhibit 6-5. A subcontractor monitors two sanitary sewer outflow streams as noted in the permit to assure that pH levels are within permit criteria. In March 2001, a permit revision changed the monitoring frequency from monthly to quarterly.

Exhibit 6-4
2001 Cooling Water Monitoring Parameters at Outfalls 001 and 002

Parameter/Units	First Quarter		Second Quarter		Permit Limit	Detection Limit
Outfall	**001**	**002**	**001**	**002**		
Flow (MGD)	0.009	1.01×10^{-5}	0.015	0.000021	0.05 MGD	0.0001
pH	8.5	6.9	6.8	6.8	6 to 9	0.1
Temperature ^{o}C	8.6	11.8	26.4	23.1	Max. 32 ^{o}C. or as noted in the permit	0.1
Hardness mg/l	240	43	272	92	None	2
Copper mg/l	0.010	0.005	<0.001	<0.001	None	0.001
Zinc mg/l	0.016	0.136	0.179	0.532	None	0.03
Chlorine mg/l	0.01	0.02	< 0.1	< 0.1	Non-Detectable	0.1
	Third Quarter		**Fourth Quarter**			
Outfall	**001**	**002****	**001**	**002**		
Flow (MGD)	.018	0.0001	.015	0.00005	See above	See above
PH	7.4	-	7.7	7.6	See above	See above
Temperature ^{o}C	21.7	-	12.7	11.7	See above	See above
Hardness mg/l	363	-	360	100	See above	See above
Copper mg/l	0.008	-	0.003	0.009	See above	See above
Zinc mg/l	0.202	-	0.065	0.075	See above	See above
Chlorine mg/l	< 0.1	-	1.4	< 0.1	See above	See above

NOTES:
**There was no water flow at sample point #2 during the last half of this monitoring period. Grab date: 8 Jan 2001, 1st quarter
MGD: million gallons/day
mg/l: milligrams/liter

As noted in Section 5, RadCon Group staff manage the HRSD radiological sampling and analysis requirements. The HRSD samples all discharge streams periodically for a full complement of metals. On an annual basis, a seven-day period of monitoring flows and samples at each of the discharge points is performed to help determine if changes to the permit are necessary. Monitoring results demonstrated that Jefferson Lab remained within the limits of the HRSD-issued permit in 2001. Jefferson Lab received a Gold Pretreatment Excellence Award for having no violations in 2001.

Exhibit 6-5
pH Sampling Results for Wastewater Discharge

Monitoring Period	Manhole D	Manhole EF
January	7.0	6.9
February	7.8	7.0
March*	8.2	7.5
Second Quarter	7.9	6.9
Third Quarter	6.4	7.1
Fourth Quarter	7.4	6.8

* Last month for monthly sampling.
Permit Limits: Calendar Month Average and Calendar Day Maximum ≥ 5.0
Detection Limit: 0.1

6.2 CONVENTIONAL AIR EMISSIONS

The Hampton Roads area of southeastern Virginia remained in attainment of ozone ambient air quality standards in 2001, though it is still considered a CAA maintenance area. The Hampton Roads area also remained in attainment for the other criteria air pollutants: particulate matter; sulfur oxides; carbon monoxide; nitrogen dioxide; and, lead. There is no required monitoring of criteria air pollutant emissions performed at Jefferson Lab except for a very small amount of ozone generation and small amounts of others due to vehicular traffic. There are no applicable NAAQS emission sources present on the site.

Note that accelerator operations result in the generation of small quantities of ozone. There are no environmental or public health effects from this generation. Ozone is monitored as a worker health issue and is appropriately controlled.

Jefferson Lab is required to notify the DEQ regarding its air pollution sources and the types of potential air pollution that may be released into the atmosphere. Natural gas-fired boilers are the primary air pollutant sources at Jefferson Lab. Reports of annual air emissions are provided to the DEQ upon request. Refer to Exhibit B2 in the appendix for information from the 2001 Source Registration Update.

Since a 1995 review of non-radiological emission sources indicated a minimal level of emissions, there have been no major changes in air emissions. Jefferson Lab, therefore, remains below any reporting thresholds. No new requirements became applicable in 2001.

6.3 SAFETY

Jefferson Lab's performance, with respect to worker safety for the 2001 CY, was as follows.

- Recordable injury case rate: 2.7 per 100 employees
- Lost Work Day case rate: 1.5 per 100 employees
- Lost Work Day rate: 12.7 per 100 employees
- Number of radioactive contaminations (external): 0

- Number of Safety Occurrence Reports (OSHA confined space, chemical exposure, and lockout/tagout incidents): 2, both minor electrical shocks.

SECTION 7
GROUNDWATER PROTECTION

7.1 INTRODUCTION

Groundwater is a vital natural resource, the contamination of which could present potential problems to the general population. Because of this, both the Federal government and the Commonwealth of Virginia regulate groundwater.

The Jefferson Lab Groundwater Protection Management Program is used as a management tool and provides a strategy to minimize impact to groundwater resources. The Program ensures compliance with Federal, State, and local regulations, other identified standards, and effective resource management practices. The Program includes a groundwater monitoring plan that serves to assess the effect of past, current, and future Jefferson Lab activities on groundwater quantity and quality.

7.2 HYDROGEOLOGY ISSUES

7.2.1 General Hydrogeology

Jefferson Lab is located in the Atlantic Coastal Plain Physiographic Province of Virginia. This province is underlain by unconsolidated sediments ranging from early Cretaceous to Holocene Age. The sediments dipping and thickening eastward consist primarily of sand, clay, silt, and gravel, with variable amounts of shell material. The hydrogeologic framework for the lower Peninsula is a series of aquifers and intervening confining units defined on the basis of the lithologic and the hydrologic properties of the unconsolidated Coastal Plain sediments.

The site is located on the eastern tip of the lower James-York Peninsula. Sediments found within 50 feet of the surface belong to the Yorktown Formation (Chesapeake Group) and overlying Columbia Group, which is comprised of four formations. These formations are similar to many Quaternary formations that comprise the riverine, estuarine, and coastal terraces of the Virginia Coastal Plain.

Jefferson Lab is situated in the northern section of Newport News, Virginia, at an average elevation of about 32 feet above MSL. The site is in a Zone C area on the local flood maps, so is not considered to be within the 100-year floodplain. The site is located in the watershed of Brick Kiln Creek, which discharges to Big Bethel Reservoir. The reservoir serves as a drinking water source for local military installations. The only long-lasting streams on the Jefferson Lab site are those due to discharges from cooling towers and groundwater dewatering operations. Small localized wet areas exist, a few are permanent, and the rest occur during periods of heavy precipitation and eventually drain by surface runoff and groundwater recharge.

7.2.2 Aquifer Information

The uppermost hydrostratigraphic unit encountered at the site is the water table aquifer, the Columbia, which is composed of sediments of the Columbia Group. The thickness of the aquifer ranges between 15 and 30 feet, with a seasonal variability of 8 feet or more. This water table aquifer, and up to nine confined aquifers, have been identified with the Atlantic Coastal Plain system. Groundwater flow within the water table aquifer is influenced by localized boundary conditions present as creeks and rivers. The first confined aquifer beneath the Columbia aquifer is the Yorktown-Eastover aquifer, composed of the coarser units of the Yorktown Formation. The upper 50 to 100 feet of the Yorktown-Eastover aquifer is usually fresh water and is one of the most important aquifers in the region.

Previous subsurface studies and groundwater elevation readings indicate that horizontal groundwater flow is

generally across the site to the east-southeast. Modeling performed during 1995, with groundwater flow and velocity reevaluated in 2001 and early 2002, indicated that the groundwater flow pattern, including seasonal variations, had not changed from earlier studies with the exception of significant local effects in the vicinity of the experimental hall dewatering system. In this area, groundwater has the tendency to work slowly towards the halls and ultimately be cycled through the dewatering system and into a site surface water channel.

7.2.3 Potential Contamination Sources

Potential groundwater contamination sources in the vicinity of Jefferson Lab could include contaminants from offsite properties that could migrate across the site. No impacts from offsite sources have been noted on the DOE site. On-site sources had included three underground storage tanks, which were removed along with any identified contaminants.

Another potential contamination source is from EHMs that are used in daily operations by Jefferson Lab staff. Proper handling and storage practices, including the standard use of secondary containment, are implemented throughout the site. All hazardous waste is managed appropriately by EH&S staff under the appropriate RCRA requirements.

Soil radioactivation is another potential source of groundwater contamination. As the facility has become fully operational, the monitoring of VPDES-permitted wells for particular groundwater quality parameters is performed at the frequencies shown in Exhibit 5-6. Jefferson Lab will maintain the capability to sample and analyze groundwater more frequently, as necessary, to ensure that effects on groundwater are minimal. From controls designed into the accelerator complex, including in-place shielding measures and through calculations, a minimal amount of soil or groundwater activation is expected on-site and no offsite effect is anticipated.

7.2.4 Groundwater Uses

The groundwater resources of the York-James Peninsula are abundant; however, the generally poor water quality limits groundwater use. Some Peninsula groundwater is used, in conjunction with area reservoirs, to supply drinking water.

Jefferson Lab withdraws groundwater from below Halls A, B, and C under the site Permit to Withdraw Groundwater, as discussed in Section 3.6. There are no projected needs for the use of groundwater on the Jefferson Lab site. The surrounding area, however, is expanding and additional sources of water to serve the city remain under investigation.

7.3 GROUNDWATER PROTECTION PROGRAM SUMMARY

Jefferson Lab's environmental protection programs have been established to allow the continued careful use of water resources and to ensure the desired maintenance of all water quality parameters to the maximum practicable extent. Existing water quality parameters are mandated under Federal and Commonwealth regulations, with the main guidance for this program being the CWA. The primary CWA objective is to "restore and maintain the chemical, physical, and biological integrity of the nation's waters." Jefferson Lab complies with the applicable standards discussed in Section 3.6.

Two significant operations that impact groundwater, described below, were addressed in the 1987 EA. Environmental impacts were minimized for both through design strategies.

- The continued withdrawal of groundwater for structural purposes and short-term dewatering for construction projects.
- The potential impact to the groundwater on the Jefferson Lab site or beyond the site limits because of construction and/or accelerator and physics program activities.

The 1987 EA found that "no significant environmental impacts are predicted." The EA

further concluded that proper design and careful operation of the accelerator would minimize any impacts, including those to groundwater. The Commonwealth's largest concern is the potential for radiological activation of the groundwater and the soil surrounding the accelerator. The 1997 EA addressed additional potential impacts based on changes in CEBAF operating parameters and the inclusion of FEL operations, and resulted in a FONSI. See Section 4.4 for additional information about NEPA.

The prevention of hazardous material and oil spills is addressed through appropriate training and awareness programs at Jefferson Lab. The prevention of oil spills is the main focus of the site SPCC Plan. The Chemical Assistance Team assists by providing immediate containment in the event of oil or hazardous material spills, and the RadCon Group addresses any activated water spills, thus minimizing potential groundwater impacts. An emergency management exercise that used an actual 'suspect mail' event in 2001 tested the Lab and area response program effectiveness. Jefferson Lab staff, local Fire Department, and the Virginia Beach HazMat team participated. A few minor opportunities for improvement were identified and addressed in 2001.

7.3.1 Groundwater Resource Protection - Quantity

Groundwater withdrawn at Halls A, B, and C is pumped to a single discharge that empties into a stormwater drainage channel. The channel is graded to allow the water to flow east, then south and off the site, eventually flowing to the Big Bethel reservoir. This dewatering is allowed by the Permit to Withdraw Groundwater and is discussed further in Sections 3.6.2.2 and 6.1.2. The Permit allows an annual withdrawal of up to twenty-three million gallons of groundwater, with the actual amount pumped significantly less. No other withdrawals or projected uses are expected.

7.3.2 Groundwater Resource Protection - Quality

The Commonwealth, through authorized discharge limits in VPDES Permit No. VA0089320, regulates accelerator-produced radionuclides that are potentially present in the groundwater. This Permit superseded a Virginia Pollution Abatement (VPA) Permit in 1996, which primarily established a groundwater quality baseline for comparison with measurements during long-term accelerator operations.

The current VPDES Permit specifies that the groundwater leaving the Jefferson Lab site shall not exceed the established baseline groundwater parameters. A groundwater monitoring program uses well sampling as the mechanism for making the determination that commitments are met. This Permit also requires keeping the DEQ informed about changes at Jefferson Lab that could affect groundwater quality.

7.3.3 Surface Water Protection

Surface water quality is maintained by discharging only unpolluted waters, such as rainwater or groundwater, to the environment. Potential sources of contamination of surface waters and associated control measures identified for the site include:

- Using proper procedures prevents releases of EHMs to surface water or the ground.
- The prevention of potential oil leaks from equipment or system malfunctions which are addressed in the SPCC Plan.
- The addition of sediments and other pollutants to surface waters from pumping at construction areas is addressed by including specific contractual requirements for any subcontractor performing earthwork to follow the practices identified in the *Virginia Erosion and Sediment Control Handbook*.
- Water within the tunnels and experimental halls may become activated from exposure to radiation. The RadCon Group procedures that address activated water management

provide for sampling and monitoring of water from any potential source within the accelerator and experimental halls.

- Groundwater surrounding the tunnel and experimental halls may become activated during beam operations. The groundwater is shielded from exposure to radiation, so minimal amounts of radiation are expected. The groundwater withdrawn at the halls is monitored under VPDES Permit No. VA0089320.

7.4 GROUNDWATER MONITORING REVIEW

Jefferson Lab's environmental monitoring program is designed to verify that any radiation exposures, as well as non-radioactive effluent releases, are below permissible limits, and that accelerator operations and physics experiments, as well as Laboratory support functions, have not affected the quality of the environment.

Radioactivation of groundwater is possible in certain locations around the accelerator complex. Massive concrete and steel shields within the accelerator beam enclosures and in the beam deceleration areas minimize groundwater activation.

The locations of the "A", "B", and "C" Ring wells, labeled as to proximity to the accelerator tunnel, are specified in VPDES Permit No. VA0089320. The permit-identified wells are used for sampling and analysis during regular accelerator operations and experimental physics activities. Exhibit 5-5 shows the locations of the background and active monitoring wells.

The "baseline" values obtained during the term of the VPA Permit helped define the operational groundwater quality limits that are listed in VPDES Permit No. VA0089320. The permit action or trigger levels, based on the statistical analysis provided to the DEQ, are shown in Exhibit 5-7. Note that the Commonwealth restricts water contamination to 1 mrem/yr., which is one-quarter of the regulated drinking water quality limit. Sampling requirements under this VPDES Permit are also presented in Exhibit 5-7. Under this permit, Jefferson Lab has to take specific corrective action if the following values are detected at either the "A" and/or "B" Ring wells: Gross Beta 50 pCi/l; Tritium 5000 pCi/l; and/or Manmade Radioactivity 1 mrem/yr. The "C" Ring wells are, at no time, to statistically exceed the background levels shown in the Permit.

Well locations are regularly reviewed, and local temporary test wells would be used to sample potential problem areas. Sampling point relocations would be considered based on study results.

SECTION 8
QUALITY ASSURANCE

Regular quality assurance (QA) efforts, which include quality control (QC) measures, are being made to ensure that Jefferson Lab's Environmental Monitoring Program is being performed in accordance with the principles of the Jefferson Lab Quality Assurance Program Manual. As well, EH&S Manual Chapter 6712, *Environmental QA,* provides methods and direction for critical and objective examination of Jefferson Lab's EP programs, practices, and performance.

8.1 QUALITY ASSURANCE IN SAMPLING PROCEDURES

The Jefferson Lab QA Program includes qualification of the laboratories that provide analytical services, verification of certification to perform analytical work, and review of performance test results. Also included in this review is the adequacy of their internal QC practices, recordkeeping, chain of custody, and the relevant portions of the QA program itself.

The RadCon Group and other program management are involved in the qualification process for environmentally sensitive services, including offsite analytical laboratories, and are responsible for auditing their own QA practices and implementing relevant QA procedures. The Jefferson Lab SA/QA

function performs independent assessments of all functional areas, including those for EP activities. The DOE oversight organizations, in their independent overview capacity, also perform periodic audits and surveillance of Jefferson Lab. No QA concerns were noted for CY 2001 regarding sampling protocols or results.

Line management responsible for the process documents all routine monitoring and surveillance sampling procedures. Some procedures have been incorporated into the EH&S Manual. Other specialized procedures have been developed in accordance with established standards, practices, and protocols. The procedures ensure that samples are representative of the media from which they are collected and will yield reliable results. Subcontractors are required to use approved documented procedures.

Universal Laboratories, Inc. (Universal Labs) collected most VPDES and HRSD permit-related water samples. Universal Labs performed all non-radiological analyses on these samples. Their subcontractor, BWX Technologies (BWX), performed all radiological analyses on identified samples. Several field audits were performed and showed Universal Labs' collection procedures were satisfactory.

Other sample collection that involves radiochemicals, including some required by the HRSD permit, is performed by the RadCon Group and analyzed in the RadCon radiological analysis lab (Building 52). Qualified Jefferson Lab staff collect samples that require general chemical analysis, which are usually not permit-related. In 2001, Jefferson Lab subcontracted with Marine Chemist, Inc. and American Medical Lab to provide general chemical analysis on samples that were not potentially radioactive.

8.2 QUALITY ASSURANCE IN ANALYSIS

Samples are analyzed for radiological and non-radiological attributes using standard EPA-approved analytical procedures. A continuing program of analytical laboratory quality control, participation in interlaboratory crosschecks, analysis of various blanks, and replicate sampling and analysis verifies data quality. The RadCon Group, Accelerator Division EH&S staff, and other responsible staff review all analytical data for samples analyzed under their subcontracts. The analytical results are reviewed relative to the accompanying QA/QC results and compared with regulatory limits for acceptability. These reviews include inspection of chain-of-custodies, sample stewardship, sample handling and transport, and sampling protocols. When applicable to the analysis requested, analytical labs must be appropriately certified. Inspection visits are made to both Universal Labs and BWX on a biennial basis. These visits confirm that analytical practices being performed are satisfactory.

Ongoing precision and accuracy are monitored by analysis of the following with each batch of samples: laboratory standards, duplicate determinations, matrix spikes, and matrix spike duplicates. These data are used to calculate the relative standard deviation. The quality of the data is then evaluated and compared to regulatory limits to determine acceptability. A range of radiochemical spikes is used to test the vendor's ability to achieve the required sensitivity for each parameter, and their reliability in detecting accelerator-produced radionuclides at or below the concentration guide standards. This enables compliance with permit requirements that QA is performed.

Jefferson Lab continues to maintain appropriate agency certifications and to incorporate certification requirements in subcontract specifications. Any equipment used for environmental monitoring is specified to have calibration certifications traceable to national standards.

Universal Labs and the RadCon radiological analysis lab participate in DOE's Quality Assessment Program (QAP) run by Environmental Measurements Laboratory (EML). BWX participates in two DOE crosscheck evaluation programs: one from the EML, and one from the Mixed Analyte Performance Evaluation Program (MAPEP).

In addition, the National Environmental Laboratory Accreditation Conference (NELAC) certifies BWX. NELAC's purpose is to establish and promote mutually acceptable performance standards for the operation of environmental laboratories. They are also EPA sample certified by both NELAC and the State of Utah, as well as with the Commonwealth of Virginia for environmental monitoring. Universal Labs, Marine Chemist, and American Medical Lab participate in state programs to maintain their state certification.

8.2.1 Radiological

Independent QA under the DOE

EML administers the DOE quality assessment program for environmental radiological analyses. The EML QA Program (QAP) is an external, independent performance evaluation program designed to test the quality of environmental radiological measurements and provides DOE with complex-wide comparability of environmental radiological analysis. Under this program, four matrices of various radionuclides are distributed semi-annually to DOE-subcontracted laboratories for analysis, with the labs required to analyze only the parameters for which they analyze under contract.

In 2001, BWX and the RadCon lab participated in the EML's QAP for radionuclides. Two sets of results for BWX and two for the RadCon lab under the QAP were available. The results, for the parameters analyzed by Jefferson Lab and those analyzed by BWX that are applicable at Jefferson Lab, are provided as Exhibits 8-1 and 8-2. Note that only selected results are presented in these exhibits. Results indicated as warnings mean they are near the limits of acceptability. BWX's overall results for QAP 54 were 96% acceptable and 4% warning. Results for the water program, which is of greatest importance for Jefferson Lab, were 100% acceptable. Overall results on QAP 55 were 100% acceptable for BWX, with RadCon lab results at 91% acceptable and 9% warning.

BWX participated in a QA program for analysis of samples under the MAPEP. Performance results for MAPEP-01-S8 and MAPEP-01-W9 were received. Results for radionuclides of interest to Jefferson Lab are shown in Exhibit 8-3. The selected results for both were 100% acceptable.

Other QA Activities

BWX also participates in a RadCon Group directed crosscheck program for selected radionuclides that includes duplicates and spiked samples provided at various times in the year. In all circumstances, the results were satisfactory in all appropriate testing categories.

In conjunction with VPDES and HRSD permit-related sampling activities, the RadCon lab runs parallel analyses on selected groundwater monitoring samples and HRSD quarterly composite samples as a QA verification.

8.2.2 Other Programs

Universal Labs, as part of its credentialing program, participates in two QA programs to ensure a high level of testing accuracy. During CY 2001, they received blind samples and conducted analyses on the samples. Exhibits 8-4 and 8-5 show the results for the parameters of interest to Jefferson Lab. Exhibit 8-4 reports information from WP-065 as conducted under the protocol of an NSI Laboratory Proficiency Testing Program. Exhibit 8-5 presents the information obtained under ERA Supply Proficiency Testing Study WP-85.

All testing protocols were done in accordance with EPA guidelines. Test results that were outside of acceptable standards were addressed by Universal Labs to determine what went wrong, and how to make improvements for the future. RadCon Group staff review the test results to ensure Universal Labs is maintaining its ability to provide quality services.

Exhibit 8-1
Quality Assurance Program (QAP 54)
Selected Results for 2001

		Reported		EML Known			
Matrix	Analyte	Value (Bq/l)	Error	Value (Bq/l)	Error	Ratio Rep/EML	Result
Water	Gross Alpha	1970.000	50.000	1900.000	190.000	1.037	Accept
(BWX)	Gross Beta	1310.000	20.000	1297.000	100.000	1.010	Accept
	H-3	98.500	19.400	79.300	2.000	1.242	Accept
	Co-60	94.700	6.300	98.200	3.600	0.964	Accept
	Cs-137	68.100	2.200	73.000	3.700	0.933	Accept
Water	Co-60	102.500	3.000	98.200	3.600	1.044	Accept
(JLab)	Co-60	102.530	3.500	98.200	3.600	1.044	Accept
	Co-60	104.970	3.000	98.200	3.600	1.069	Accept
	Cs-137	76.170	3.800	73.000	3.700	1.043	Accept
	Cs-137	77.660	3.200	73.000	3.700	1.064	Accept
	Cs-137	75.880	3.100	73.000	3.700	1.039	Accept

Matrix	Analyte	Value (Bq/filter)	Error	Value (Bq/filter)	Error	Ratio Rep/EML	Result
Air	Co-60	20.440	0.680	19.440	0.500	1.051	Accept
(JLab)	Co-60	20.500	0.670	19.440	0.500	1.055	Accept
	Co-60	20.000	0.660	19.440	0.500	1.029	Accept
	Cs-134	2.190	0.210	2.830	0.160	0.774	Warning
	Cs-134	2.850	0.240	2.830	0.160	1.007	Accept
	Cs-134	2.720	0.170	2.830	0.160	0.961	Accept
	Cs-137	9.470	0.480	8.760	0.340	1.081	Accept
	Cs-137	9.160	0.500	8.760	0.340	1.046	Accept
	Cs-137	9.260	0.520	8.760	0.340	1.057	Accept
	Mn-54	7.250	0.570	6.520	0.280	1.112	Accept
	Mn-54	7.100	0.540	6.520	0.280	1.089	Accept
	Mn-54	6.720	0.520	6.520	0.280	1.031	Accept

BWX: BWX Technologies, Inc.; JLab: Jefferson Lab
Only selected results that had some relevance to Jefferson Lab operations are provided in this Exhibit.

Exhibit 8-2
Quality Assurance Program (QAP 55)
Selected Results for 2001

		Reported		EML Known			
Matrix	Analyte	Value (Bq/l)	Error	Value (Bq/l)	Error	Ratio Rep/EML	Result
Water	Gross Alpha	1210.000	40.000	1150.000	115.000	1.052	Accept
(BWX)	Gross Beta	6790.000	70.000	7970.000	800.000	0.852	Accept
	H-3	233.000	20.000	207.000	2.690	1.126	Accept
	Co-60	212.000	10.000	209.000	7.590	1.014	Accept
	Cs-137	44.800	1.700	45.133	2.467	0.993	Accept
Water	Co-60	205.000	6.000	209.000	7.590	0.981	Accept
(JLab)	Co-60	207.000	6.000	209.000	7.590	0.990	Accept
	Co-60	210.000	5.000	209.000	7.590	1.005	Accept
	Cs-137	47.500	3.000	45.133	2.467	1.052	Accept
	Cs-137	47.400	2.000	45.133	2.467	1.050	Accept
	Cs-137	47.700	3.000	45.133	2.467	1.057	Accept

Matrix	Analyte	Value (Bq/l)	Error	Value (Bq/l)	Error	Ratio Rep/EML	Result
Air	Co-60	18.500	0.800	17.500	0.470	1.057	Accept
(JLab)	Co-60	20.300	0.800	17.500	0.470	1.160	Warning
	Co-60	19.000	0.600	17.500	0.470	1.086	Accept
	Cs-134	11.700	0.600	12.950	0.362	0.903	Accept
	Cs-134	12.500	0.600	12.950	0.362	0.965	Accept
	Cs-134	13.000	0.500	12.950	0.362	1.004	Accept
	Cs-137	20.000	0.900	17.100	0.580	1.170	Warning
	Cs-137	19.300	1.000	17.100	0.580	1.129	Accept
	Cs-137	18.700	1.000	17.100	0.580	1.094	Accept
	Mn-54	94.000	3.300	81.150	4.760	1.158	Accept
	Mn-54	92.100	3.500	81.150	4.760	1.135	Accept
	Mn-54	90.900	3.500	81.150	4.760	1.120	Accept

BWX: BWX Technologies, Inc.; JLab: Jefferson Lab
Only selected results that had some relevance to Jefferson Lab operations are provided in this Exhibit.

Exhibit 8-3
Mixed Analyte Performance Evaluation Program (MAPEP) for 2001

Sample ID: MAPEP-01-S8
(BWX)

Parameter*	Reported Value	Reference Value (Bq/kg)	Result	Bias (%)	Acceptance Range (Bq/kg)
Co-57	101	103	A	-1.9	72.10 - 133.90
Co-60	1390	1270	A	9.4	889.00 - 1651.00
Cs-134	84.4	91.7	A	-7.4	63.77 – 118.43
Cs-137	1230	1240	A	-0.8	868.00 - 1612.00
Manganese-54	215	203	A	5.9	142.10 - 263.90

Sample ID: MAPEP-01-W9
(BWX)

Parameter*	Reported Value	Reference Value (Bq/l)	Result	Bias (%)	Acceptance Range (Bq/l)
Co-57	142	143	A	-0.7	100.10 - 185.90
Co-60	150	141	A	6.4	98.70 – 183.30
Cs-134	23.9	28.5	A	-16.1	19.95 – 37.05
Cs-137	271	286	A	-5.2	200.20 - 371.80
Manganese-54	258	246	A	4.9	172.20 – 319.80

Notes:
A: result acceptable (Bias ≤ 20%)
-A, +A: mean result acceptable (10% < bias ≤ 20%)
W, +W: result acceptable with warning (20% < bias ≤ 30%)
+N, -N: result not acceptable (bias >30%)
*Only selected results that had some relevance to Jefferson Lab operations are provided in this exhibit.

Exhibit 8-4
Selected Results from Universal Laboratories Performance Evaluation Reports
NSI Laboratory Proficiency Testing Program Study WP-065

Sample Category	Parameter	Units	Reported Value	True Value	Acceptance Limits	Results
Trace Metals	Aluminum	µg/L	460.0	328	269 - 389	Not Acceptable
	Cadmium	µg/L	450.0	455	388 - 517	Acceptable
	Cadmium	µg/L	480.0	455	388 - 517	Acceptable
	Chromium	µg/L	565.0	589	513 - 666	Acceptable
	Copper	µg/L	508.0	509	462 - 559	Acceptable
	Lead	µg/L	1420.0	1439	1265 - 1606	Acceptable
	Manganese	µg/L	992.0	1014	911 - 1127	Acceptable
	Nickel	µg/L	1724.0	1744	1584 - 1945	Acceptable
	Zinc	µg/L	5607.0	537	474 - 606	Not Acceptable
pH	pH (1)	-	9.23	9.30	9.01 - 9.58	Acceptable
pH	pH (2)	-	9.23	9.30	9.01 - 9.58	Acceptable
Mercury	Mercury	µg/L	12.7	14.1	10.6 - 17.6	Acceptable
Minerals	Specific Conductance (at 25°C)	µmhos/cm	680.0	656	592 - 721	Acceptable
	Total Hardness as $CaCO_3$	mg/L	166.0	174	158 - 190	Acceptable
	Calcium	mg/L	39.7	37.8	33.6 - 43.0	Acceptable
Residual Chlorine	Total Residual Chlorine	mg/L	0.58	0.581	0.363 - 0.799	Acceptable
Residue	Non-filterable Residual TSS	mg/L	92.0	94.0	73.1 - 102	Acceptable
	Filterable Residual TDS	mg/L	406.0	405	347 - 463	Acceptable
	TS	mg/L	493.0	495	440 - 551	Acceptable
Demand	COD	mg/L	103.0	101	75.0 - 118	Acceptable
	TOC	mg/L	37.9	40.0	33.4 - 46.2	Acceptable

Note: Only selected results that had some relevance to Jefferson Lab operations are provided in this Exhibit.
µg/L: micrograms per liter
µmhos/cm: micromhos per centimeter
COD: Chemical Oxygen Demand
TOC: Total Organic Carbon
TSS: Total Suspended Solids
TDS Total Dissolved Solids
TS: Total Solids

Exhibit 8-5
Selected Results from Universal Laboratories Performance Evaluation Reports
ERA Supply Proficiency Testing Study WP-85

Sample Category	Parameter	Units	Reported Value	True Value	Acceptance Limits	Results
Trace Metals	Aluminum	µg/L	404	383	316 - 451	Acceptable
	Beryllium	µg/L	16.2	16.3	12.5 - 18.6	Acceptable
	Cadmium	µg/L	54.4	50.2	42.0 - 58.3	Acceptable
	Chromium	µg/L	93.8	87.2	73.7 - 100	Acceptable
	Copper	µg/L	118	118	104 - 132	Acceptable
	Lead	µg/L	152	153	128 - 178	Acceptable
	Manganese	µg/L	219	213	190 - 237	Acceptable
	Nickel	µg/L	238	237	208 - 268	Acceptable
	Silver	µg/L	45.6	44.7	37.7 - 51.5	Acceptable
	Zinc	µg/L	155.9	144	124 - 166	Acceptable
pH	pH	S.U.	6.99	6.90	6.72 - 7.08	Acceptable
Mercury	Mercury	µg/L	8.5	7.73	5.73 - 9.70	Acceptable
Minerals	Conductivity at 25°C	µmhos/cm	429.1	420	387 - 453	Acceptable
	TDS	mg/L	360	355	269 - 441	Acceptable
	Ca Hardness as $CaCO_3$	mg/L	122.22	94.3	77.5 - 115	Not Acceptable
	TS	mg/L	372	376	332 - 414	Acceptable
Hardness	TSS	mg/L	49	49.1	37.0 - 52.6	Acceptable
	Calcium	mg/L	38.72	37.7	33.5 - 42.9	Acceptable
Residual Chlorine	Total Residual Chlorine	mg/L	1.6	1.94	1.57 - 2.31	Check for Error
Demand	COD	mg/L	57	60.3	42.0 - 73.7	Acceptable
	TOC	mg/L	24.28	23.8	19.8 - 27.7	Acceptable

Note: Only selected results that had some relevance to Jefferson Lab operations are provided in this Exhibit.

SECTION 9
REFERENCES

Industrial Wastewater Discharge Regulations
Hampton Roads Sanitation District
July 1, 1999 revision.

U.S. Department of Energy
Air Emissions Summary Report
Continuous Electron Beam Accelerator Facility
July 14, 1995.

U.S. Department of Energy
Hydrogeologic Review
Continuous Electron Beam Accelerator Facility
September 1995.

U.S. Department of Energy
Spill Prevention, Control, and Countermeasure Plan
Thomas Jefferson National Accelerator Facility
December 2001 revision.

U.S. Department of Energy
Environmental Assessment DOE/EA-0257
Continuous Electron Beam Accelerator Facility
Newport News, VA
January 1987.

U.S. Department of Energy
Environmental Assessment DOE/EA-1204
Change in Operating Parameters of the Continuous Electron Beam Accelerator Facility and the Free Electron Laser
Thomas Jefferson National Accelerator Facility
Newport News, VA
October 1997.

U.S. Department of Energy
Environmental Assessment DOE/EA-1384 (under preparation)
Proposed Improvements at the Thomas Jefferson National Accelerator Facility
Newport News, VA

Virginia Erosion and Sediment Control Handbook
Virginia Department of Conservation and Recreation
Division of Soil and Water Conservation
1992.

SECTION 10
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EXTERNAL

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APPENDIX

Section A
Applicable Site Standards

Standards in the Work Smart Standards (WSS) Set

The DOE uses the WSS Process to identify EP (environmental protection), health and safety hazards, and the standards describing mitigation measures. Through this process, the particular hazards associated with the Lab were identified, along with the corresponding laws, regulations, and other standards necessary and sufficient to protect the worker, the public, and the environment against the identified hazards. This summary of applicable environment, health, and safety requirements for Jefferson Lab is the WSS Set. The WSS Set was recently amended in March 2002.

The applicable EP and public health-related standards, including the four site operating permits, are listed in Exhibits A1, A2, A3, and A4. Various Occupational Safety and Health Act (OSHA)-related standards are included in the WSS Set, but since these contain minimal EP controls, compliance with OSHA was not singled out in this report. Compliance with each of the listed standards, by category, is presented in the parts of Section 3 referenced in the exhibits.

Administrative Laws and Regulations (AL&R) List

The AL&R List was developed along with the WSS Set and identifies EH&S implementation standards and requirements that are of an administrative nature and not directly related to hazards. Together, the WSS Set and the AL&R List contain almost all of Jefferson Lab's EH&S requirements. The EP and public health-related AL&R documents are not specifically listed here, but include some U.S. Department of Transportation (DOT) hazardous material regulations and a section of the U.S. Code dealing with generators of hazardous waste. AL&R items are not specifically listed below but are included in the appropriate topical discussions in the SER.

Exhibit A1
Federal Laws and Regulations Included in the WSS Set

SER References		Citations	Titles
LAWS (by subject)			
3.5	Asbestos	15 U.S.C. § 2641 et seq.	Asbestos Hazard Emergency Response Act of 1986 (training)
3.6	Water	33 U.S.C. § 1251 et seq.	Federal Water Pollution Control Act (Clean Water Act)
3.4	Radiation	42 U.S.C. § 2282a	Price-Anderson Amendments Act of 1988 (referenced in 10 CFR 835)
3.7	Public Health	42 U.S.C. § 300f et seq.	Safe Drinking Water Act, as amended
3.5	Air	42 U.S.C. § 7401 et seq.	Clean Air Act and Amendments
3.9.5	Emergency Response	42 U.S.C. § 9601 et seq.	CERCLA
3.9.5	Emergency Planning	42 U.S.C. § 11001-11050	SARA Title III EPCRA
3.3& 3.9.5	Pollution Prevention and Waste	42 U.S.C. § 13101 et seq.	Pollution Prevention Act of 1990

Exhibit A1 (Continued)
Federal Laws and Regulations Included in the WSS Set

SER References	Citations	Titles
REGULATIONS	**Title 40 - Protection of Environment**	
3.4.1		Parts 71, 834, and 835
3.4.1		Part 10
3.5	Subchapter C	Various Air Programs
3.6	Subchapter D	Various Water Programs
3.3	Subchapter I	Various Waste Programs including RCRA
3.9	Subchapter J	Various Superfund, EPCRA Programs
3.6.2	Subchapter N	Part 403
3.5	Subchapter R	Part 763
	Title 49 - Transportation	
3.8.4 Transportation	Subchapter C	Various Hazardous Materials Regulations
DOE GUIDANCE		
3.10.3	O 5400.5	Radiation Protection of the Environment, Chapter II and IV
EXECUTIVE ORDERS (EOs)		
3.9.3	13101	*Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition*
3.9.4	13123	*Greening the Government Through Efficient Energy Management*
3.9.5	13148	*Greening the Government Through Leadership in Environmental Management*

Notes: See referenced sections for full titles of noted laws or permits.

Exhibit A2
Permits, State Laws and Regulations Included in the WSS Set

SER References	Citations	Standard	Issued	Effective
LAWS				
3.3.1	Title 10.1 - Conservation	Chapter 14, Virginia Waste Management Act		
3.6	Title 62.1 - Waters of the State, Ports and Harbors	Chapter 3.1, State Water Control Law		
PERMITS				
3.6.1.2	DEQ No. VA0089320	VPDES Permit - Specifies allowable groundwater and surface water quality on-site during accelerator operations. Assures groundwater unaffected at and beyond site boundary.	7/16/96	Through 7/16/2006

Exhibit A2 (Continued)
Permits, State Laws and Regulations Included in the WSS Set

SER References	Citations	Standard	Issued	Effective
PERMITS				
3.6.1.2	DEQ No. VAG253002	General Permit for Cooling Water Discharges - Authorizes cooling water discharges within identified discharge limitations.	[applicable 9/99]	Through 3/1/2003
3.6.2.1	HRSD No. 0117	Industrial Wastewater Discharge Permit - Limits wastes to be discharged to sewerage.	10/87	3/1/2002 3/1/2007
3.6.2.2	DEQ No. GW0030800	Permit to Withdraw Groundwater - Authorizes maximum quantities of water to be withdrawn by dewatering of area under experimental halls.	11/1/94	Through 10/30/2004
3.3.2	4727-45-01	South Carolina Radioactive Waste Transport Permit – Authorization to transport LLW within the state	9/14/2001	Through 12/31/2001
REGULATIONS				
3.5	9 - VAC (Environment)	Chapter 5, Air Quality		
3.3	9 - VAC (Environment)	Chapter 20, Waste Regulations		
3.6	9 - VAC (Environment)	Chapter 25, Water Quality		
3.6.2	*none*	HRSD Industrial Wastewater Discharge Regulations		

Note: See referenced SER sections for full titles of noted laws or permits.

Exhibit A3
Other Standards Identified in the WSS Set

Category/SER References	Citations	Standard
REGULATIONS		
3.8.4	49 CFR 177	Hazardous Materials Regulations
DOE GUIDANCE		
3.10.3	O 5400.5	Radiation Protection of the Environment, Sections 1a and 1b
VIRGINIA PLAN		
3.9		Virginia Emergency Management Operations Plan
EH&S MANUAL		
1, 3.3, 3.4, 3.5, 3.6, 3.8, 3.9, 4.2, & 8	Assorted Chapters and Appendices referenced within.	Manual sections include topics on: ionizing radiation protection, asbestos, emergency planning, air and water quality, oil spill prevention, waste minimization, recycling and waste management practices.

Exhibit A4
Transportation-Related Standards

SER Section	Transportation-related Information	Applicable Standards
3.6.2.3	SPCC Plan: oil and oil-product issues	40 CFR 112
3.4.1	Radiation Protection: packaging and transport of radiological materials	10 CFR 71
3.9.5.1	Emergency Response: response actions in the event of a transportation emergency that include reporting and notification requirements	CERCLA/SARA VA Emergency Management Operations Plan
3.9	Emergency Response: response actions in the event of a transportation emergency	EH&S Manual Standards: Appendix 3510-T3 and Chapter 6732
3.3.1	Hazardous Waste: on-site movement and preparation for offsite shipment	EH&S Manual Standard: Chapter 6761

Section B
Site Usage Information

Exhibit B1
Control Chemicals and Products Approved for Use in 2001

Pest Control	Herbicides/Landscape Maintenance
Contrac	Damoil
Demand CS	Diazinon 4E
Dicofol 4EC	Dicofol 4EC
Dursban Pro	Dimension
Flyteck	Diometom
Insect Guard	Fore Tree & Ornamental Fungicide
MaxForce Bait	Fusilade II
Mosquito Dunks	Merit
Precor 1%	MSMA Target 6.6
PT 270 Dursban	Roundup
PT 515 Wasp-Freeze	Super Trimec
Quintox Rat & Mouse Bait	
	Termite Control
	Cyrene TC

Exhibit B2
Source Registration Update for Calendar Year 2001

Ref. No.	Equipment	Annual Fuel Process Rate (Million Cu. Ft. Burned)	Process Volume % Annual Throughput			
			J-M	A-J	J-S	O-D
HB-1	CLVR.BRKS.	2.4	40	26	10	24
HB-2	CLVR.BRKS. P-142-30	2.4	40	26	10	24
HB-3	CLVR.BRKS. CB-760-60	5.4	35	24	15	26
HB-4	CLVR.BRKS. CB-760-60	5.4	35	24	15	26
HB-5	BRYAN F-450 WG	1.5	25	25	25	25
HB-6	BRYAN F-90 WG	1.2	48	20	0	32
HB-7	BRYAN F-90 WG	1.2	48	20	0	32
HB-8	PSB Fin Tube Radiator	1.5	85	7	0	8

Process: Natural Gas (under 10 MMBTU / Hr)
Heat Content: 1050 MMBTU / Cu. Ft.
Annual Schedule: 24 hrs / day, 7 day / wk, 52 wks / yr